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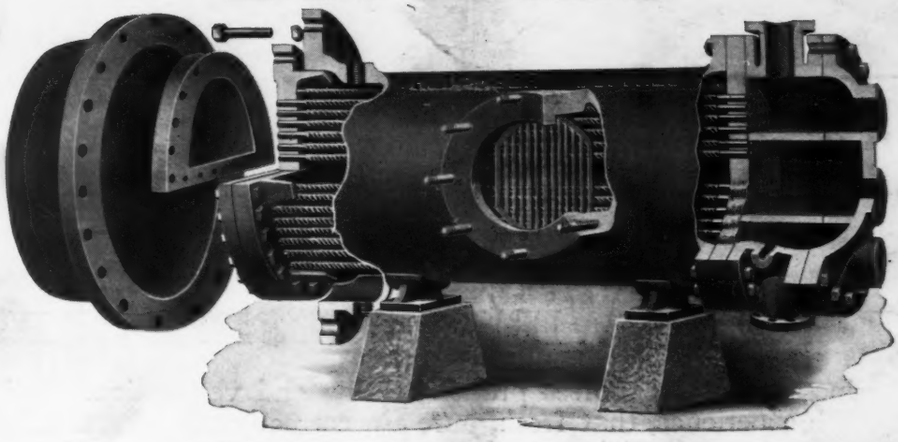

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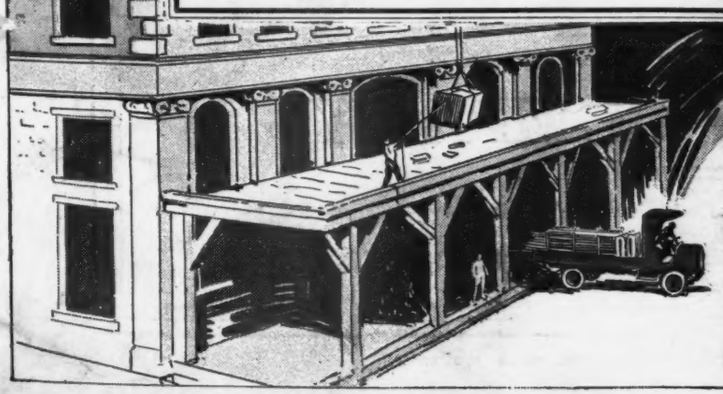

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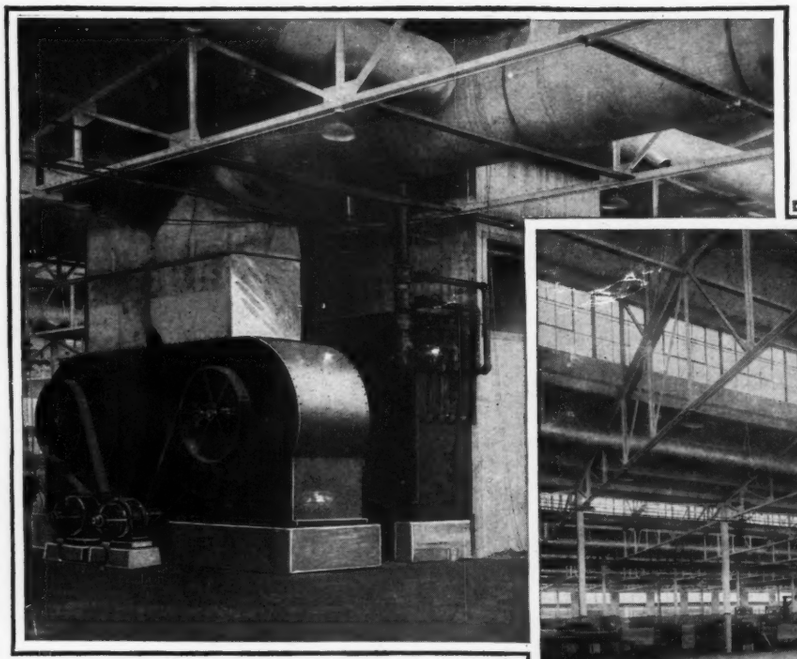

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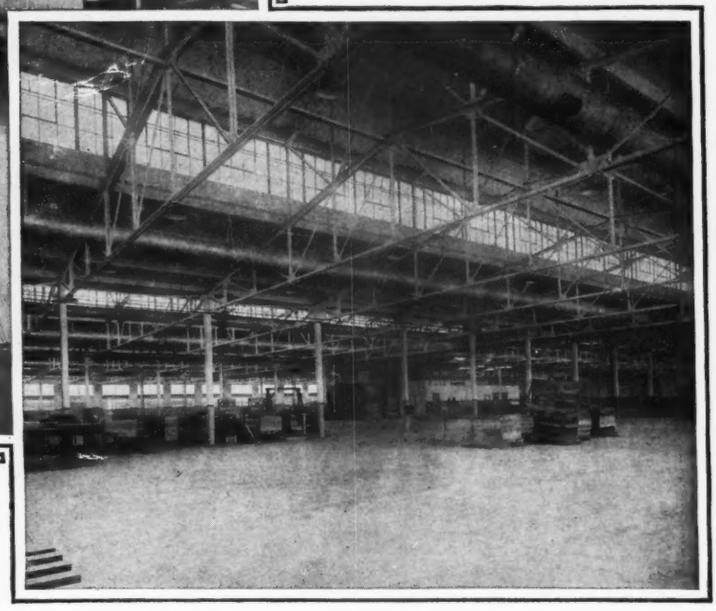

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SEPTEMBER, 1920

BACK TO FIRST PRINCIPLES IN FUEL ECONOMY

Waste of One-Quarter of all the Coal Mined Throws Heavy Responsibility on Shoulders of Heating Engineers

BY WILLIAM LA FONTAINE.

"What has struck me most forcibly in all my experience," writes Mr. La Fontaine, "is the utter waste of fuel evident on every hand. My observation and experience have taught me that at least 90% of all heating jobs of whatever kind are defective in one or more vital spots. For instance, right here in Scranton, almost every steam boiler installation has either the boiler too small, too little radiation, or both. The result is fuel waste by the forcing of fires to a degree that shocks the interested heating man.

"The great tendency is to shift the responsibility to the manufacturer when anything goes wrong with the product. Our policy is just the opposite. We take all responsibility with our customers, settle with or satisfy them and then, if there is anything wrong with the goods we ourselves fight it out with the manufacturer. This policy works out splendidly. The customer is satisfied, we get along very well, and the manufacturer has only one party to deal with—us. Needless to say, we have the manufacturers' good-will and, in most cases, hearty co-operation.

"The point I wish to make is that it pays to do all that is possible to make the heater do all that it is capable of doing. The householder must have instructions. His interest must be aroused and, unfortunately, it seems that the interest of the great bulk of householders will not be aroused except when their pocket books are in danger of becoming empty. The present high prices of coal are, then, not an unqualified evil. There are many difficulties in the way of securing better heating installations and their proper care. The only solution of these difficulties seems to be education through publicity."

THE National Conservation Commission reports that in 1907 the per capita consumption of coal was 5.6 tons and the WASTE was estimated at 3 tons per capita. In the beginning of mining the coal abandoned in the mine averaged as much as two or three times that taken out. The chief part of the remaining waste of coal is after it reaches the householder—in imperfect combustion in furnaces, boilers and other fire-boxes, in bad installations, defective heaters, etc.

In the opinion of the United States Geological Survey, "if the rate of increase that has held for the last fifty years is maintained, the supply of *easily available* coal will be exhausted before the middle of the next century, (2050 A. D.)"

The above are not idle words but are based upon the result of careful, scientific investigations by agencies of unimpeachable integrity. They sound a note of very serious warning to the American people.

"Last year" says Van H. Manning, until recently director of the United States Bureau of Mines, "the United States mined 600,000,000 tons of coal, the greatest production ever witnessed in the world, and of this amount we WASTED 150,000,000 tons, or 25% through inefficient use." This refers to 1916-1917. Mr. Manning is now in private life devoting himself to private business. The meagre salary paid to Mr. Manning by our Government was absolutely all out of proper proportion to his ability. In the loss of Mr. Manning our Government suffers a loss that will be difficult to repair. It will be exceedingly hard to find a man with the ability combined with the *heart-felt interest* that Mr. Manning ever displayed in coal conservation.

COAL THE KEY OF INDUSTRIAL LIFE.

Coal is such a wonderful and useful product of Nature that it behooves every householder and every other user of coal to use every possible means from now on to save and conserve our coal. Do you realize that on coal depends the running of the wheels of practically every industry? Do you realize that as our precious coal deposits gradually disappear some *substitute must be found by our men of genius,* otherwise our progress, as well as world progress, must gradually come to an end? Coal is the great producer of heat, light and power. We *must* economize on our coal until discovery and invention find a substitute.

The abundance or scarcity of food has a great effect on the general interests of a country and the comfort of its inhabitants. The wealth and prosperity of the United States must be attributed in very great measure to the abundance of coal. Even for the most ordinary uses of domestic economy the scarcity of coal in some parts of the world causes great hardship to the people, while an abundance of coal is a very great advantage indeed.

Coal, as we know, is the vegetation of former ages—geological periods—the product of their sunshine and their showers, treasured for the enjoyment of the present. Coal has twice the heating value of the very best wood.

Notwithstanding the improvements recently effected, those important branches of the art of living, heating and ventilation, are still in a comparatively rude and imperfect condition, that is, to what they will some day be. May science speed that good day on!

It is not with all countries as with us; and not even

our stores of coal are inexhaustible as evidenced by the researches of various agencies. It is an unworthy, and, in the real sense of the word, an unhuman maxim that bids us "let posterity look out for itself." If the intensely absorbing passions for present selfish gain will not let us begin practicing coal economy NOW, we may at least seek to devise ways and means to perfect plans so as to be in readiness when the urgent necessity for economy does come. With the present high prices of coal, and the probability is that they will never be lower, it appears that the necessity for economy is already here.

It is common to hear the argument, that before our coal is gone something else will be discovered as a substitute. One may very bluntly ask these over-confident and super-optimistic folks, "What will that something be?" At present the only substitute that can be seen is to practice such rigid economy as to make the coal now wasted in one year last two or three, and this the writer believes to be quite possible.

WHAT THE COAL WASTAGE ACTUALLY MEANS.

Householders in the United States use between 75,000,000 and 100,000,000 tons of coal per year. Now if, as Director Manning says, we could, by proper methods, etc., save 150,000,000 tons of coal per year it stands to reason that all the homes in the United States would get about two years free use of coal that is now wasted, assuming that the householder uses 75,000,000 tons per year. To make the matter clearer suppose that the people of our country did save 150,000,000 tons of coal in one year. For the next two years the householder would get free coal. There would be that much coal stored up by the saving. In 100 years the saving would be 15,000,000,000 tons. If, in the meantime, the household consumption increased by virtue of the increase in population to 150,000,000 tons per year, it can easily be seen that the saved 15,000,000,000 tons would last the householders of our country 100 years longer than if we didn't save. When looked at in this way we see what a debt we owe to those that are sure to come after us. It should be a matter of conscience for each individual to do whatever he can in every way to conserve all our natural resources, and of these natural resources, coal is the most valuable.

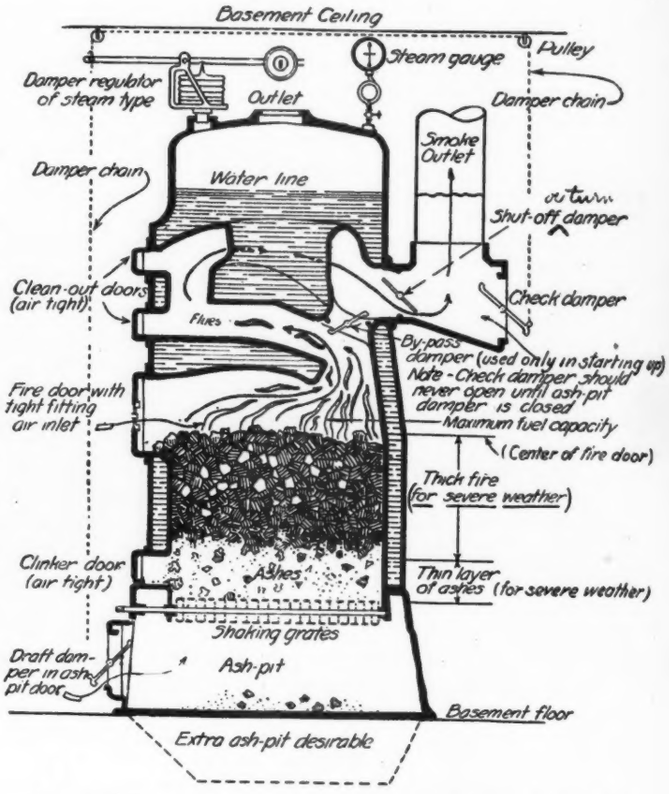
PRACTICAL METHODS OF COAL ECONOMY.

Getting down to practical methods of coal economy let us see how by the intelligent, interested application of well-known methods a high degree of efficiency may be attained. There is no magic or great mystery about it. A little hard work and study is all that is needed. If all the well-known and well-tried methods of saving coal were put in effect all over the United States there would be an annual saving of easily 150,000,000 tons.

A careful study of the two illustrations will show the average interested person the details of his heater. When these details work together properly there is a minimum of waste and a maximum of heat. By details are meant the parts of his heater. Most people want to learn of new methods. They are averse to trying out or learning the old methods. Learn the old methods *first,* then try to improve on them. There is then time enough to learn new and untried methods, or invent others. Note carefully the "shut off" damper. This damper is used to prevent heat from escaping up the flue before it is absorbed into the heating surfaces of the heater. The "check damper" is to be used in conjunction with the "shut off", sometimes called turn damper and choke damper. Cases have been known where 50% of the total heat created by the heater has been wasted by lack of use or an unintelligent use of these dampers. They should be so adjusted as to allow as little air as possible to pass through the heater consistent with sufficient heating and ventilating requirements. Don't let the chimney "hog" your heat and therefore your coal. See that the heater and all pipes are covered with asbestos of good quality and of sufficient thickness to prevent a waste of heat into the cellar or other place where the heater may be located. As much as 25% loss may occur by the neglect of this one item alone.

EFFECT OF LEAKY JOINTS.

See that all "cleanout" doors are tight. Air filtering or sucked in around loose joints or clean-out doors will chill the fire and thus dilute the heat as water dilutes milk. The writer has experimented with loose clean-out doors



From "Purchase and Use of Coal for Heating Homes" Issued by University of Illinois.

FIG. 1—SECTIONAL VIEW OF TYPICAL STEAM HEATING BOILER.

and the results show that steam pressure at once is lowered when clean-out doors are "cracked" as much or rather as little as one-eighth of an inch all around. No more air should go through or into the heater than is absolutely necessary for perfect and complete combustion, and "perfect" and "complete" combustion are not synonymous terms, as is generally supposed. Combustion may be complete yet a big loss of heat may occur because of a great excess of air going through the heater. But when combustion is perfect all the gases have been burned completely while at the same time the temperature of the fire has reached the highest possible. Excess of air dilutes the heat, lowering its intensity, though all the gases may be burned completely. It follows that we should strive for perfect combustion, rather than complete combustion.

LOSSES OF HEAT CAUSED BY DIRTY FIRE SURFACES.

Dirty fire surfaces cause great losses of heat. In fact the dirty fire-surface acts as an insulator and prevents

the heat from getting effectively into the water, if a boiler be used, or into the iron if a warm-air furnace be used. A special investigation by the Institute of Marine Engineers disclosed that soot on heating surfaces decreases the efficiency of heat absorbing surfaces in the following ratio:

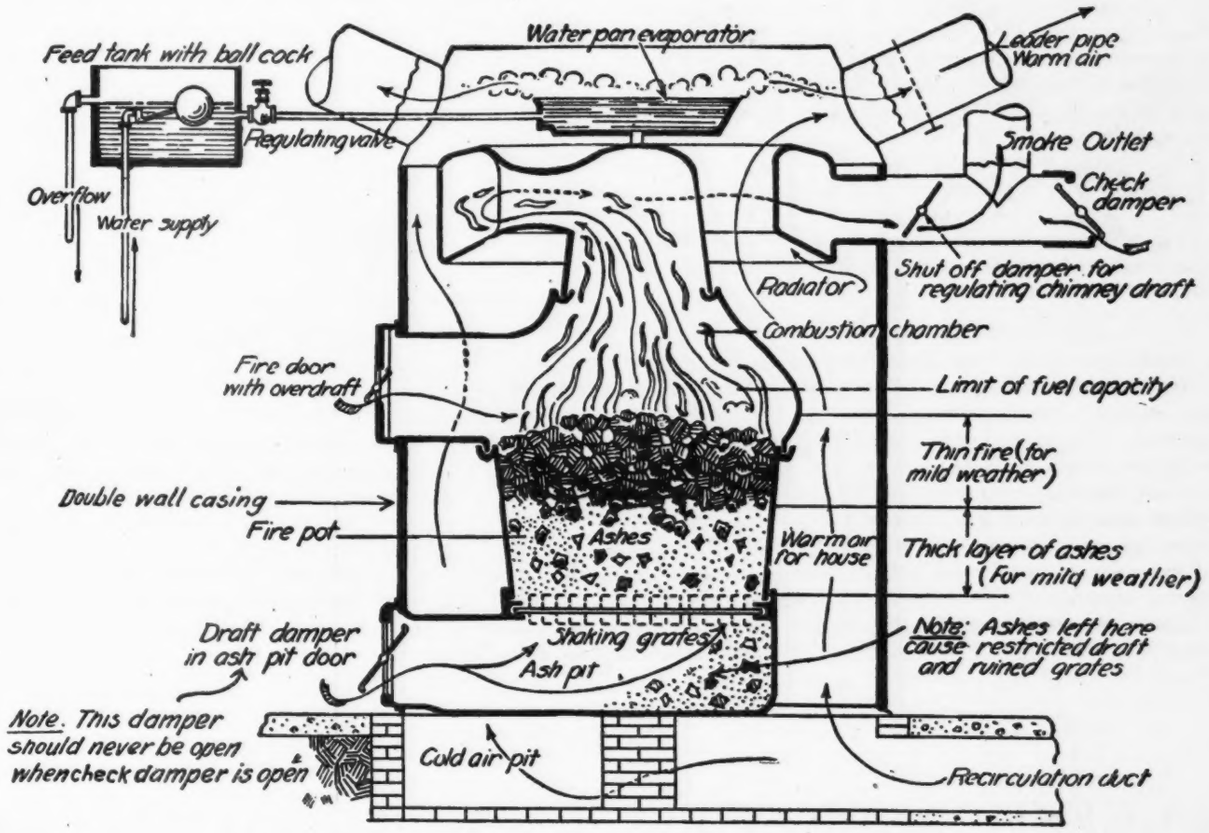
Soot thickness inches.	Efficiency loss per cent
1-32	9.5
1-16	26.2
1-8	45.2
3-16	69.0

A study of the above figures will show very strikingly the great necessity of *clean* heating surfaces in coal or other fuel-burning appliances. Marine engines and boilers *must* be at a high state of efficiency at all times, hence the tests frequently made for the purpose of basing trustworthy conclusions.

Allowing live coals to fall into the ash-pit is another source of loss. Sometimes this develops into a great loss. The writer has frequently observed great cans of ashes standing on the curb waiting for the ash man that were really not ashes at all but were 75% coal. Especially does this happen when the grates are not suited to the coal or the coal to the grates. Excessive shaking of fires is another prolific source of loss of coal through the grates. If the fire must be shaken excessively there is something radically wrong somewhere. Usually it is the draft. Have it remedied at once. A defective or poor draft is the cause of great losses. A strong, snappy draft will burn your coal perfectly and leave nothing but fine ashes or completely burned out cinders behind. A strong, snappy draft may be throttled down by the use of the turn-damper and check damper and still be full of life and ginger, creating a bright, even though a slow fire.

LARGE PERCENTAGE OF BOILER FAILURES CAUSED BY POOR DRAFT.

Ninety percent. of boiler and furnace failures, when these are not too small, are caused by defective or poor drafts. This is about the hardest lesson for the average person to learn, namely, that no boiler, furnace, or stove will "draw" unless attached to a good chimney. Heaters of any and all kinds have no power in themselves of "drawing." They depend wholly upon the chimney to which they are attached. The first requisite, and the one usually most neglected, is a good chimney, properly lined, big enough inside, and high enough outside to create a strong draft. Don't blame a heater until you are absolutely sure that your chimney is powerful enough to carry that heater. See to it, also, that the chimney has free surroundings, that is, that no objects such as buildings, trees, etc. interfere with the free escape of the gases created by the heater fire.



From "Purchase and Use of Coal for Heating Homes," Issued by University of Illinois.

FIG. 2—SECTIONAL VIEW OF TYPICAL WARM-AIR FURNACE.

Don't open fire-door to check the fire. As soon as you do this the cold air rushes over the fuel bed and chills the fire and heating surfaces, at the same time carrying the diluted heat up and out into the chimney—a pure, dead loss. The only time that a fire-door should be used to check the fire is when *no heat* is wanted for long periods of time, and just enough fire is needed to prevent it from going out altogether. This method of checking fires is used when "banking" fires to avoid the necessity of building new ones.

PROTECTION OF GRATE BARS.

Ashes should not be allowed to accumulate under the grates. No grate bars ever made or that ever will be made can stand a fire above them and ashes heaped up plumb against them from the under side. Grate bars will last indefinitely if good judgment is used when shaking them

and no ashes are allowed to accumulate under them. It is even advisable to keep as few burning coals as possible on the face of the bars (upper side in contact with fire) as an intense fire with a closed ash-pit damper may cause them to warp. Always, if possible, allow as much ashes on top (not under) the grate bars as possible.

UNDERSIZING BOILERS AND RADIATION.

If a steam boiler is used to heat the house sufficient radiation should always be provided. A locomotive boiler placed in the cellar could not heat any house if the radiation in the rooms were too little. On the other hand, a boiler too small will not heat a larger amount of radiation than it is capable of. This truth ought to be self-evident but it is surprising how little it is known or rather fully realized in practice. The writer's experience has given him good reason to believe that 90% of house-heating boilers are under-size and that 90% of the radiation in the rooms is deficient in capacity, that is, short in square feet area. The same criticism applies to warm-air furnace installations. Either the furnace is too small, the warm-air leader pipes too small combined with too little pitch, the furnace wrongly locat- with too little pitch, the connections of leader pipes from furnace to the piping to rooms "choked" by radically reducing the area, the air from *outside* taken from wrong side of house, no provision for *inside* cold air to supply furnace, etc.

DESIRE FOR CHEAP JOB LIKELY TO PROVE COSTLY.

The cause of these deficient and defective installations is manifold. The main exciting cause is the overwhelming desire of the owner for a *cheap job*. The owner will allow five or six heating contractors to bid on the work. He will allow these five or six contractors to beat each other to pieces on the rocks of competition. The owner will accept the price of the lowest bidder without question and, of course, award the lowest bidder the work without inquiring into the reputation of the heating contractor for efficiency or inefficiency of installation. The result is that the owner gets a "cheap" job in the beginning and a mighty dear job in the end.

As previously stated, about 90% of all heating jobs need remodeling or altering in some important manner in order to bring them up to their highest possible efficiency. The next factor after correct installation is the *human* factor. Sometimes the writer believes that the human factor is the main factor. But however this may be, it is certain that no matter how well a heating job may be installed and no matter how nicely the size of the warm-air furnace or steam or water heating boiler may be proportioned to the work they are called upon to do, IF THE HEATING SYSTEM ISN'T *OPERATED PROPERLY*, correct installation will avail but little. It is absolutely necessary that the owner gets books and *reads them*, that he *thinks* while he reads these books, that he thinks *after* he reads, and that he *applies* what he learns in order to give his book knowledge the actual, acid test, as the chemist says. The owner must give his heating plant personal attention, remembering that the *total* efficiency of his heating plant is the installation plus personal attention, or in other words the mechanical element plus the human element. The human brain must make the mechanism right, install it right in a building built right and tight, attached to a chimney that "draws" right, set the whole mechanism right, then *keep it right.*

OWNERS MUST BECOME INTERESTED IN FUEL CONSERVATION.

In the practical operation of heating plants of any kind or type many other factors enter in. We have enumerated the principal ones above. The main thing is to get the owner *interested*. INTEREST IS THE MAIN-SPRING OF AMBITION and ambition is the feeling that stimulates the wonderful intellect to all achievement. Without the ambition to conserve our precious fuel resources the most advanced knowledge and the finest heating systems are as nought. To get our people interested in fuel conservation is the great thing. When this is really and actually and effectively achieved then and only then will there be real hope that the enormous and criminal fuel waste now going on will diminish.

SUGGESTIONS ON STORAGE AND HAND-FIRING OF SOFT COAL

Those who have been obliged to take up the use of soft coal, instead of anthracite, in their homes or in larger heating installations, will find considerable useful information in two bulletins recently issued by the Iowa State College of Agriculture and Mechanic Arts.

The three losses which may take place in large quantities of stored soft coal are given as: 1. Loss of heating value on account of oxidation of combustible portions of the coal; 2. Slacking or breaking up of the coal into fine particles which, in many cases, cannot be burned efficiently. 3. Spontaneous combustion. The losses due to slacking and spontaneous combustion are of much more importance than the loss of heating value.

As far as Iowa soft coal is concerned, the following directions on storage are given:

SUGGESTIONS ON STORAGE

Do not pile Iowa screened lump coal over 8 ft. high. Coal which contains much dust or fine particles should not be piled over 4 or 5 ft. high. Iowa steam coal should be piled in small piles not over 3 or 4 ft. in height, which can be readily moved in case of spontaneous combustion.

Store a larger size of coal than is to be used, if possible. The loss due to slacking will be minimized if this is done. The larger sizes of coal are also less liable to take fire spontaneously.

Keep out dust as much as possible, by storing only screened coal, and by careful handling in piling.

In piling coal, see that the lumps and fine coal are distributed evenly throughout the pile.

Do not store near external sources of heat, such as boilers, etc., as many cases of spontaneous combustion have been traced to such sources.

Avoid alternate wetting and drying. Coal stored under cover should be dry when stored.

If coal is stored in sheds, they should be rain and wind tight; otherwise nothing is gained over storage in the open.

Do not ventilate coal piles with pipes and flues which may do more harm than good.

If a coal pile shows signs of heating, spread out the entire

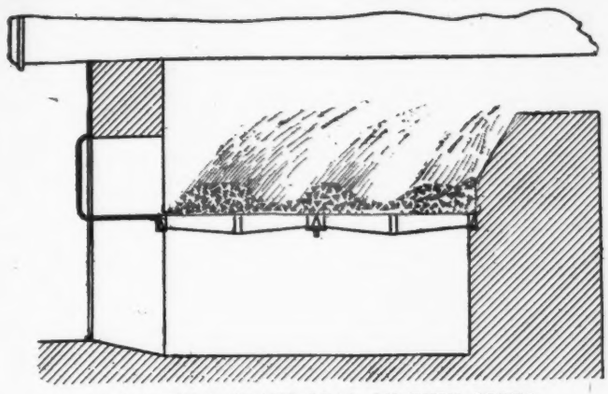


FIG. 1—FIRE FRESH COAL ON THIN SPOTS.

pile so that it can cool off. Coal which has been stored six weeks or more, if cooled off and repiled will seldom heat again.

Storage under water will prevent slacking to a large extent, and will prevent any losses due to fire. Many engineers believe that storage under water is the only practical way of storing Iowa steam coal.

The losses due to spontaneous combustion are often not confined to the coal pile, as records show many disastrous fires from this cause. Ordinarily it is difficult to put out a fire in a coal pile with water from a hose, as a crust forms over the fire so that the water cannot reach it and it is usually necessary to remove the coal from around the burning part before the fire can be put out. If a coal pile catches fire, the entire pile should be spread out to cool off.

NOTES ON HAND-FIRING

When soft coal is placed on a hot fire, a considerable quantity of gas, commonly called volatile matter, is driven off rapidly. This process, which is known as distillation, takes place whether or not air be present. However, to secure the entire heat of the volatile matter, these gases must

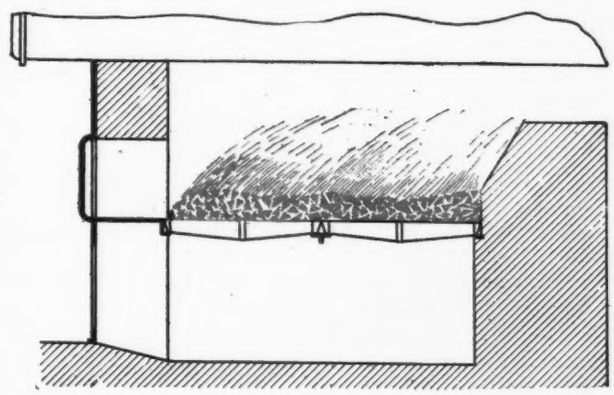


FIG. 2—CARRY A THIN, LEVEL FIRE OVER THE ENTIRE GRATE.

be completely burned before passing out of the combustion chamber. Most coals used in Iowa have a high percentage of volatile matter, representing, in some cases, over 40% of the heating value.

Since distillation takes place in the first few minutes after firing, and the rate of flow of air through the fuel bed is practically constant, extra air must be admitted above the fire during this time, in order to secure complete combustion. It is usually found necessary to admit this extra amount of air either through the damper openings in the fire doors, or by leaving the fire doors open slightly for a few minutes immediately after firing.

As the amount of gas given off depends entirely upon the amount of fresh fuel, small amounts should be fired at frequent intervals to maintain as nearly as possible the proper proportions between fuel and air supply. The fire door dampers should be opened, or the doors cracked slightly for 2 or 3 minutes after firing. The fire doors should be closed as soon as the gas is burned or the furnace will be cooled off and heat wasted.

CARRY A THIN, LEVEL FIRE OVER THE ENTIRE GRATE.

A fuel bed of uniform thickness should be carried over the entire grate, so that combustion takes place at the same rate in all parts of the furnace. If the bed is not of uniform thickness too much air may flow through the thinner spots, while too little may flow through the thicker parts due to their greater resistance.

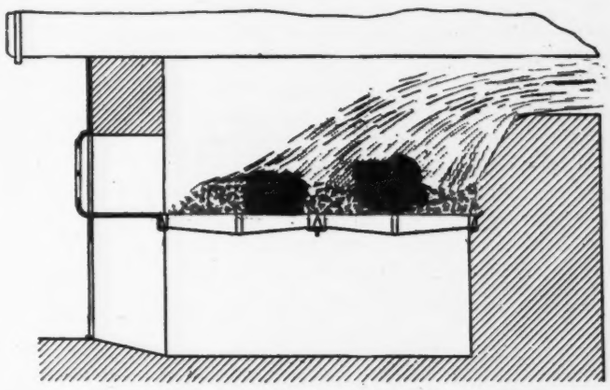


FIG. 3—OPEN FIRE DOOR SLIGHTLY FOR TWO OR THREE MINUTES IMMEDIATELY AFTER FIRING.

The thickness of the fuel bed should vary according to the draft, but in all cases should be thin enough to allow sufficient air for complete combustion to flow through it. Just how thick a fuel bed should be cannot be said offhand, as the thickness which should be maintained in any particular plant depends upon the kind and size of fuel and the draft. With coals commonly used in Iowa, fuel beds should be from 4 to 6 in. thick to give the best results in most plants. Fuel beds less than 4 in. thick have a tendency to allow air to pass through without giving up its oxygen, on account of the small holes that are usually found in them.

FILL UP THE BRIGHT OR THIN SPOTS.

As the fuel does not burn at the same rate over the entire grate, thin spots will develop in any fuel bed. This difference in rate of combustion will be due to clinker, caking of the coal, or difference in the sizes of coal.

The fireman should place the fresh coal on these thin or bright spots, rather than cover the entire fuel bed. By doing so he will be able to keep the fuel bed level with little raking or poking. With short intervals between firings there is small chance of the thin spots burning out entirely, and

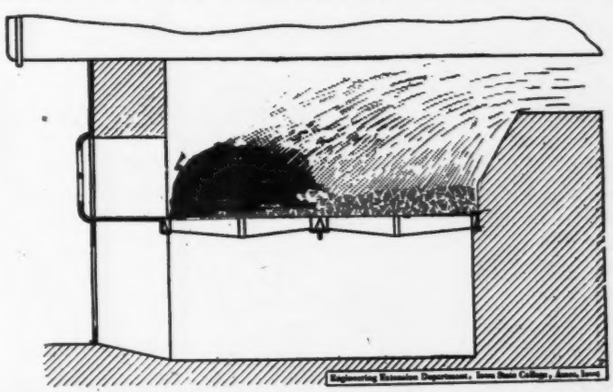


FIG. 4—USE COKING METHOD FOR FIRING LARGE CHARGES.

thus letting large amounts of cold air into the furnace through holes in the fuel bed.

Uneven burning due to difference in sizes of coal can be largely overcome by breaking all lumps to first size. Caking is usually caused by firing too much coal at a time, especially if the coal contains much slack. Of course, if high or thick spots in the fire are caused by clinker, it will be necessary to clean the fire to get the fuel bed to burn uniformly, as no air can get through the clinker.

CAUSES OF CLINKER.

As clinker is caused by melting of ash, any coal will form clinker if the ash is heated to the melting temperature. The most common causes of clinker are thick fires, stirring the fire, firing coal containing much slack, closed ash pit doors and fire in the ash pit. Clinker forms in a thick fuel bed because the smaller supply of air through the grate permits the ash to become heated to the melting point. By stirring the fire, ash is lifted into the hotter parts of the fire and fused to clinker. Coal containing much slack may cake or form a crust over the fire, thus stopping the flow of air through the fire in the same way as a fuel bed which is too thick. Closed ash pit doors and fire in the ash pit cause over heating of the grates and the ash above them.

CLEANING FIRES.

On account of the fact that clinker and coarse ash will not pass through the grates, it is necessary to clean the fires from time to time.

In the side method of cleaning fires, one side of the fire is cleaned at a time. The good coal is moved to one side of the grate, with the hoe or slice bar and the exposed clinker and ash removed. After one side of the grate has been cleaned, the good coal is all moved to that side and the rest of the grate cleaned. The burning fuel is then spread over the entire grate.

In the front of rear method of cleaning the burning coal is pushed back to the bridge wall and the coarse ash and clinker removed, after which the coal is spread over the grate.

In many plants, especially small ones, the fireman has other duties, in addition to firing, so that large charges must be fired at rather long intervals. When such is the case, the coking method of firing is recommended, the fresh coal being fired at the front of the grate, after most of the live coal has been pushed back.

CATECHISM ON SAFE STORAGE OF COAL

THE prospect of another period of uncertainty, to express it mildly, regarding the coal supply, lends special timeliness to a recent report issued by the Bureau of Mines, under the authorship of H. H. Stoeck, on "Safe Storage of Coal." It is written in the form of a catechism and is presented herewith, substantially in full:

Who should store coal?

Every consumer should store what he can.

The domestic consumer should place his order early in the spring and store his supply as early as he can get it.

Power plants should maintain a reserve supply, adding to and subtracting from the storage so as to make uniform deliveries possible through the period of the year most favorable to transportation. A reserve supply, sufficient for 30 to 90 days continuous operation is desirable.

Why store coal?

To guard against interruptions of supply.

To take advantage of lower prices in the spring and summer.

To give steady employment to miners instead of seasonal employment.

To transport coal in good weather, when it costs less.

What would be the result of more storage?

It would permit coal mines to operate continuously instead of intermittently. Intermittent operation increases the cost per ton for mining, and makes the yearly return to labor low. These conditions contribute to serious instability and unrest in one of the fundamental industries of the country and this can be changed only by coal buyers doing their part to insure steady work.

The railroads are now required to transport the maximum amount of coal during the winter months when traffic is most interfered with by bad weather and when the maximum amount of coal is used by the railroads to handle other coal. The railroads now use nearly 30% of the total output of coal. About one-third of their freight traffic is hauling coal, so that economy of fuel used by the railroads will produce a considerable gross saving.

Railroads are required to transport large amounts of coal in the autumn months when they are operating under pressure to move the crops. If some of this load can be transferred to the Spring and early Summer months when crop transportation is at a minimum, further economies will be effected.

Would retail dealers benefit by early ordering and storage?

The cost of delivery is less in spring and summer, when the work of delivery crews can be well planned and be made continuous, than in winter, when bad weather may interrupt deliveries.

What are the objections to storing coal?

Money is tied up for some months unless deferred payments can be arranged.

If coal must be rehandled this increases the cost.

If the coal is friable every rehandling produces fine coal or slack which, in excess, is sometimes more difficult to burn efficiently.

Storage facilities cost money to provide, maintain, and operate.

If fine coal is stored there is some risk of spontaneous combustion of coals other than anthracite.

Does coal deteriorate in heating power when stored?

There is no appreciable loss of heating power because of age.

Is there chance of loss in the storage of coal?

Sometimes coal heats spontaneously. If allowed to heat too much it loses in heating value and must be removed and cooled. This makes an expensive rehandling. Considering the number of storage operations this chance is extremely remote.

Is this true of anthracite coal?

No.

What kinds of bituminous coal can be stored?

Any kind, providing proper precautions are taken. Some kinds of bituminous coal are more liable to spontaneous combustion than others, but it is not possible to say of any given kind of coal that it will or will not ignite under favorable conditions.

What about lignite?

Lignite and subbituminous coal have a stronger tendency toward spontaneous combustion than most bituminous coals,

but with care they can be stored. Since they lose moisture rapidly the degradation in size is an objection to storage.

What is the cause of spontaneous combustion?

It is apparently due to an oxidation of the coal surface. This generates heat. If the heat is not dissipated, the temperature will continue to rise. The oxidation is more rapid at increased temperatures so that the process is self-aggravating. A temperature may finally be reached where the coal is afire.

How may heating be detected?

By the odor given off from the pile or by thrusting iron rods into the pile and feeling them with the hand or by a thermometer. Steam should not be confused with smoke, for water vapor coming out of the pile in winter time may produce visible steam when there is no appreciable heating within the pile. Temperature tests with an iron rod should be made if possible; actual temperature determinations should be made with any suitable type of thermometer.

What temperature is dangerous?

When the temperature rises above 140° F., the pile should be carefully watched. If it rises rapidly to 150° or 160° steps should be taken to move the coal and cool off the heated part.

What is the best way to stop heating which has started?

The best way is to move the coal as quickly as possible to a place where it can cool off. It should be allowed to become thoroughly cooled before replacing it in storage, or, better still, used at once and not returned to storage.

Can heating be stopped by putting water upon the pile?

Only if it is applied in sufficient quantities to extinguish the fire and cool the mass. The water must reach the point at which heating occurs, for it can do but little good if the stream is only played upon the surface of the pile. Most bituminous coal cokes on heating, and a shell of tarry material is formed about the hot spot which prevents the water reaching it. To be sure that the water reaches the burning coal, it is usually necessary to dig into the pile and turn it over. It is usually better to move the coal and not depend on water.

Does time have any effect on the heating of coal?

Three-fourths of the coal fires studied have occurred within 90 days after the coal was placed in storage. Oxidation is most rapid on a freshly-broken surface.

What effect has sulphur on the heating of coal?

Oxidation of the pyrite in the coal also produces heat and assists in breaking up the lumps and thus increases the amount of fine coal in the pile. Rise in temperature, either from external or internal causes promotes the oxidation of pyrite and thus increases the liability of the coal to spontaneous combustion. It is wise to select low sulphur coals for storage if procurable, but it must not be taken for granted that a low sulphur coal will necessarily store well, or that a high sulphur coal will fire in storage.

Is it bad practice to mix different kinds of coal in storage?

This is generally believed to be the case, but there seems to be no logical basis for the belief except in so far as mixing may produce conditions within the pile that lead to heating.

What precautions prevent spontaneous combustion?

Avoid storing fine coal. Store screened nut and lump. Avoid external sources of heat, such as steam pipes, warm flues, and boiler settings. Avoid making fresh broken surfaces in handling the coal into storage.

Avoid foreign combustible matter which may itself spontaneously heat, such as rags, paper, waste, etc.

Avoid sticks and timbers in the pile which, surrounded by coarser coal, form ducts or flues concentrating the warm currents from the coal below.

What other precautions should be taken in storing in a cellar?

Take care to prevent an accumulation of fine coal in one part of the pile as, for example, directly below the opening through which the coal has been put in. If this fine coal is scattered through the pile it is not likely to heat.

Is there any danger of spontaneous combustion in small piles, say less than twenty tons, with these precautions observed?

No.

STORAGE OF 20 TO 200 TONS.

What are general principles to be observed in storing bituminous coal in small amounts, 20 to 200 tons?

The prevention of degradation, of segregation, of exposure to oxidation under conditions favorable for the generation of heat, and of exposure to outside sources of heat.

What is meant by degradation?

The reduction in size of the coal. This increases coal surface. It has already been explained that oxidation of the surface of the coal is the cause of its heating. The finer the coal the greater is its surface in proportion to its volume, and the greater likelihood of its heating.

How may breakage of coal during storage be avoided?

By taking care not to drop it from a height. If there is a choice of coal for storage the least friable should be chosen.

What is meant by segregation?

The separation of the fine coal from the coarser pieces. If the coal is allowed to roll or slide, this segregation takes place, and furnishes favorable conditions for heating at some place.

How may segregation be avoided?

By being careful not to dump coal at a single point in a pile, where fine coal would collect. The coal should be spread in uniform horizontal layers.

Is there much fire risk to a building in which coal is stored in amounts up to 200 tons?

No; whenever heating occurs it progresses slowly and can usually be detected by the odor from the pile long before there is any danger.

What precautions should be taken?

The coal pile should be inspected daily to note whether there are any signs of heating, such as odor, visible vapor, warmth to the hand, or of rods thrust into the pile.

STORAGE OF 200 TO 1000 TONS.

Does this call for additional precautions?

Yes; for the larger the pile, the more difficult it is to watch and the more important it is to prevent heating.

Is there much difficulty in storing screen coal in piles of 200 to 1000 tons?

Not if precautions are taken to prevent breakage and subsequent segregation.

Why is it easier to store lump coal?

Because the heating surface is relatively small and the open spaces between the lumps permit the air to pass through the pile and carry off any heat generated.

Do fires occur in lump coal storage piles?

Very seldom, if at all, and upon investigation it will usually be found that the coal has been broken by being dumped from a height, the fire starting in the fine coal thus produced.

Can Slack coal be stored safely?

Slack coal and screenings have been safely stored in large amounts in the air but the only absolutely safe way is under water. If this is impracticable keep air out of the coal pile as much as possible by compacting the pile and approximating the conditions that prevail in under water storage.

Can mine-run coal be stored safely under ordinary conditions?

The presence of fine coal and dust makes its storage difficult. Many varieties may be successfully stored in small, low piles. In storing mine-run coal it should be placed in uniform layers and segregation of the sizes prevented. The piles should be as low as space will permit, carefully watched, and provision made to move the coal if heating occurs.

Is a definite place for storing necessary?

Before it is time to begin the actual storing, a suitable place

should be prepared and a definite policy outlined far enough in advance so that everyone who will have to do with the storing may receive *definite instructions* and not merely suggestions. It is unwise to wait until the coal to be stored has been delivered and then dump it anywhere on the ground merely to release the cars promptly. Storage instructions should be prepared in advance and carried out to the letter. Many failures in storing coal have been due not to faulty instructions, but to the fact that the instructions have not been followed.

What is the advantage of careful inspection during delivery?

To be certain that fine coal or slack has not been mixed with the size of coal that it is desired to store.

Is it better to store coal in the open or under cover?

It seems to make little difference.

Since the heat is due to oxidation, what may be done to prevent circulation of air through the pile?

Storage under water completely excludes air and prevents heating.

Storage in air-tight containers, such as cement bins sealed at the bottom, also prevent heating.

If piles are so built as to be as dense as possible the air flow will be retarded.

Is it desirable to store coal in pits?

Pits will serve to restrict air movement through the pile, but as they are usually filled by backing the wagons or trucks over the pile, the fine coal thus produced is extremely likely to start a fire.

What kind of surface should coal be stored upon?

A concrete floor is best, but a hard clay bottom thoroughly drained is desirable if the former is too expensive. Coal should not be dumped on ground covered with ashes or refuse of any kind, and the ground should always be cleaned of vegetation and leveled off so that the reclaiming of the coal may be done as easily as possible and the dirt or refuse will not become mixed with the coal.

What objection is there to dumping coal from a trestle?

Breakage results; the legs of the trestle also tend to produce channels for air circulation. If the coal is of a size or grade likely to heat it is not safe to dump it about the legs of a trestle.

Does moisture have any effect in connection with spontaneous combustion?

The evidence of chemical laboratory experiments is contradictory. It is not wise to put wet fine coal upon a pile if it can be avoided, or to store coal on a damp base. Water or melting snow, trickling through a coal pile will tend to choke the interstices and change the ventilating conditions, possibly leading to heating.

STORAGE OF OVER 1000 TONS.

What special precautions should be taken in storage in large piles?

The bigger the pile the more likely that somewhere within it conditions favorable to heating may occur, and the more difficult it will be to move the coal in case of trouble. We are therefore warranted in taking unusual care to prevent likelihood of heating.

Is it well to ventilate these large piles?

The effect of ventilating coal piles is a disputed point, but the weight of evidence in the United States seems to be against the practice.

THE ARGUMENT FOR THE UNIT SYSTEM OF VENTILATION AS A FUEL SAVER

Experiences in a City School Building Where the Expense of Remodeling Was a Prime Factor

BY H. E. WESTOVER,

Chief Engineer, Board of Education, St. Joseph, Mo.

EDITOR'S NOTE—*While the first part of the accompanying report, reproduced through the courtesy of the American School Board Journal, may be objected to as dealing with a building in which the unit system supplanted an antiquated and poorly-designed fan blast system, nevertheless, the results obtained, together with the comparative air diffusion tests in three other school buildings, contain data which are in a form to challenge the attention of all engaged in this class of work.*

IN the early spring of 1919, it was decided to install a new heating and ventilating system in one of the older St. Joseph school buildings that had been served for several years by a central fan system with hot-air furnaces. This building had eight classrooms on two floors, the entire basement being taken up by boys' and girls' toilet rooms, and the heating equipment. This equipment consisted of four hot-air tubular furnaces with a motor-driven fan of approximately 10,000 cu. ft. per minute capacity.

These four furnaces with plenum chamber, fresh-air-supply room, fan room and coal storage occupied the major portion of the basement. The fresh air was taken through two windows at one side and to the rear of the furnaces, and as these windows were near the ground level, there was a constant trouble and annoyance from trash and dirt which got into the air supply. The heat ducts had been originally installed largely as the tinsmith saw fit, with the result that the air distribution was very uneven.

NECESSITY OF REMODELING THE DUCT SYSTEM.

In considering the different questions incident to the installation of a new plant, it was realized that the location of the fresh-air supply would have to be changed and the entire duct system remodeled. It was this condition that first led the writer to consider the possibility of installing some type of direct steam heating, with mechanical ventilation to be secured without expensive duct reconstruction. At that time, however, the principle of unit heating and ventilating had not been called to his attention.

Before any definite conclusion had been reached, the writer heard of the unit system of ventilation as it was

then being used in the east in conjunction with direct radiation. This seemed to offer possibilities, and letters of inquiry were sent to a number of users. The replies to all of these were so favorable that it was deemed advisable to follow up the inquiries with a personal investigation.

FIFTEEN PLANTS VISITED USING UNIT VENTILATING SYSTEMS.

In the course of this investigation about fifteen plants in six different cities were visited and all were found to be giving satisfaction. All of these plants were using the unit system for ventilation only, depending upon auxiliary direct radiation to meet heating requirements. The point upon which the writer had the most doubt was the ability of the machine to furnish the necessary amount of air without an attendant noise that would be a detriment to class-room work. In all of the machines seen, this difficulty had been overcome.

The net result of this investigation was the decision to install the unit system in the building in question with the important chance of having all heating and ventilating handled by one unit without any direct radiation.

This installation was made in the summer of 1919 and the plant put into operation in early September.

With the exception of a short shut-down during the coal shortage, the plant has been in continuous operation ever since. The results obtained have fully equalled expectations and up to the present time no reasons have been given to make the writer regret his decision. It is unfortunate that there has been no opportunity given for a test of this system at extremely low temperatures, as the minimum encountered was only 5° F.

NO OBJECTIONABLE NOISE FROM MACHINES.

The fear of possible objectionable noise from the machines has not been realized in any degree. All instructors in the school are well pleased with the system and unite in saying that they prefer it to any other that they have encountered. The fact that they can see for themselves that they are getting fresh air direct from outdoors makes a strong appeal.

SPACE OCCUPIED BY HEATING EQUIPMENT MADE AVAILABLE FOR OTHER PURPOSES.

An incidental advantage that was secured from this installation was the releasing for other purposes of the space originally occupied by heating equipment. One large room has thus been made available for manual training.

Although this plant seemed to be entirely satisfactory, the writer desired to get some definite data on its performance as compared with other types in order to base recommendations for future installations. It was not a mere question as to the ability to provide sufficient heat, as this can be easily handled. The main point was: Which system would give the most efficient ventilation at all times and under all conditions? It is not sufficient to pour a given quantity of fresh air into a room in a stated period of time, but the fresh air must also be equally distributed to all parts of the room and this raises an entirely different problem.

TESTS FOR AIR DIFFUSION IN THREE TYPICAL SCHOOL BUILDINGS.

The true index of this distribution of air supply or diffusion, is the maintenance of equal temperatures at different distances from the floor line and at different parts of the classroom.

In order to make a test as to this condition, a standard was arranged to carry three thermometers, one 6 in. above the floor, one 5 ft. and one 9 ft.. The plants to be tested were the best of their types in the district. Care was taken in all cases to see that air leakage was not excessive. It is not contended that the conditions found could not be improved by changes in plant design, but these conditions did exist in plants that were supposed to be all that could be desired.

The plates that follow are largely self-explanatory but a brief discussion of the salient features is deemed advisable.

TESTS IN BLISS SCHOOL.

The first plant to be tested was that in operation at the Bliss school, a comparatively new building, erected in the summer of 1916. This was of the split-system type and had never failed to furnish all necessary heat, and very few complaints had ever been made as to foul air. The room selected was on the first floor, southeast corner, and the tests were made immediately after the dismissal of classes in the afternoon.

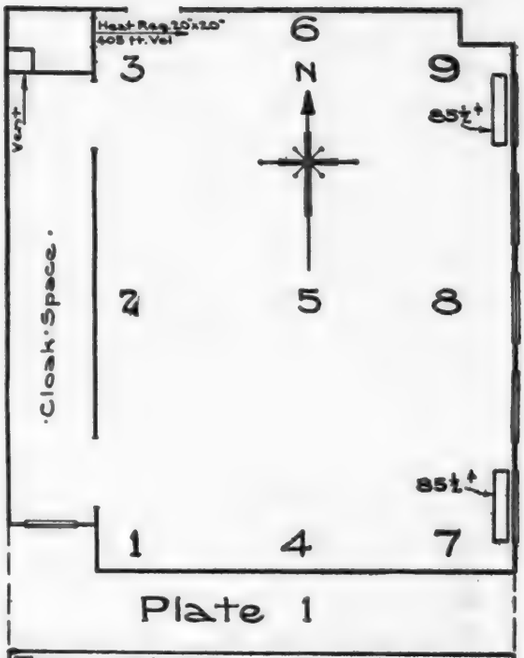


Plate 1

Temperature Readings				
Station	6 in. From Floor	5 ft. From Floor	9 ft. From Floor	Greatest Temperature difference
1	64	70	76	12
2	66	73	75	9
3	66	72	77	11
4	65	72	77	12
5	66	71	78	12
6	67	71	76	9
7	66	72	76	10
8	66	70	78	10
9	69	72	78	9

FIG. 1—TEST IN BLISS SCHOOL.

Fig. 1 shows the general arrangement of this room, together with the locations of the stations where temperature readings were made. The location and size of the heat register and the direct radiation are also shown. The readings at each station were made simultaneously, and the uniformity of the room temperature was checked by an auxiliary thermometer.

These readings showed an almost uniform variation at the different heights, as well as a fair uniformity in all parts of the room at the same level. The readings indicated such a decided stratification that it was decided to make smoke tests and to endeavor to photograph the results.

With this end in view a camera was placed at Station 1 and an exposure was made before the ignition of the smoke bombs. This picture is marked Plate A. Two smoke bombs were then placed on the bottom of the heat register and simultaneously ignited. Plate B was made 30 secs. thereafter and plainly shows the heavy cloud of smoke in the corner near the register with already a lighter cloud near the windows. No diffusion in the room could be detected at this time. Plate C was made 1 min., 30 sec. after Plate B, and at that time there was fairly good diffusion over most of the room with the exception of the corner where the camera was located. Counter currents over the direct radiation were noticed, but the camera failed to get them.

PLATE A.

PLATE B.

PLATE C.

PLATE D.

VIEWS IN BLISS SCHOOL AT DIFFERENT PERIODS OF TEST.

Plate D was made 3 min., 15 sec. after Plate C and by that time the diffusion was fairly uniform and the smoke was beginning to dissipate. No active lines of air travel could be observed except over the direct radiation and a slight movement through the cloak-room doors next to the vent register. The whole appearance of the smoke was that of a still fog. No stratification could be detected. The air volume and velocity were as noted.

TESTS IN WASHINGTON SCHOOL.

The second plant to be tested was that in operation at the Washington school, one of our best buildings, and the results from this plant had been entirely satisfactory to the patrons and teaching staff. It was of the plenum type, air being supplied from a central fan. The room selected was near the center of the building and on the west side. This was made at the same time of day as the first one. Fig. 2 shows the general arrangement of the room, together with the location of the stations where temperature readings were made and the size and location of the heat register. The volume of air supplied to this room was slightly in excess of that found in the first test, although the velocity was less. The readings were made in the same manner as in the first case and the results found were largly similar. In making the smoke test, the bombs were placed in the same relative position in the heat register. The camera was located near Station 9 and an exposure was made before the ignition of the bombs, as shown in Plate E.

Plate F was made 30 sec. after the ignition of the bombs and plainly shows the manner in which the smoke cloud hugged the ceiling and worked toward the cold window surface. The smoke can also be seen just starting over the top of the cloakroom door on its way to the vent register. Plate G was made 2 min. after Plate F and shows the major portion of the smoke cloud in the upper half of the room and towards the windows. The stratification is plainly shown, together with the strong tendency towards the cloak-room doors, with a corresponding lack of movement towards the camera.

Plate H was made 3 min. 15 sec. after Plate G and at the time of maximum density and uniformity of the smoke cloud, taking the room as a whole. The stratification is still plainly evident, extending almost entirely across the room. There were other smaller strata in various

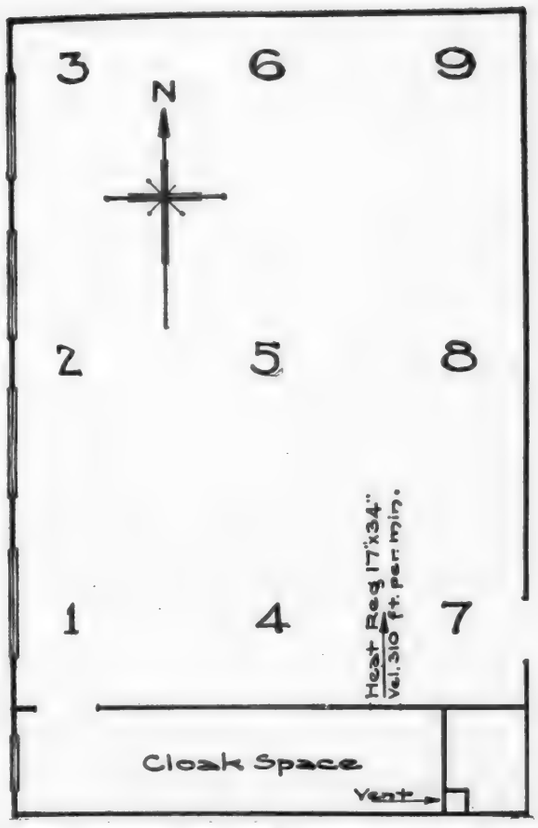


FIG. 2—ARRANGEMENT OF ROOM IN WASHINGTON SCHOOL.

Temperature Readings.

Station	6 in From Floor	5 Ft. From Floor	9 Ft. From Floor	Greatest Temperature Difference.
1	67	70	72	5
2	67	70	74	7
3	66	70	73	7
4	68	71	77	9
5	67	71	77	10
6	67	70	76	9
7	69	71	78	9
8	68	71	78	10
9	67	72	78	11

TEMPERATURE READINGS IN WASHINGTON SCHOOL.

parts of the room that the camera failed to catch. At no time did the smoke cloud approach average density near the camera and along the east wall. With the exception of the pull over and under the cloak-room door, there was no appreciable air travel. The smoke had the same still fog characteristic with the exception of very pronounced stratification.

PLATE E.

PLATE F.

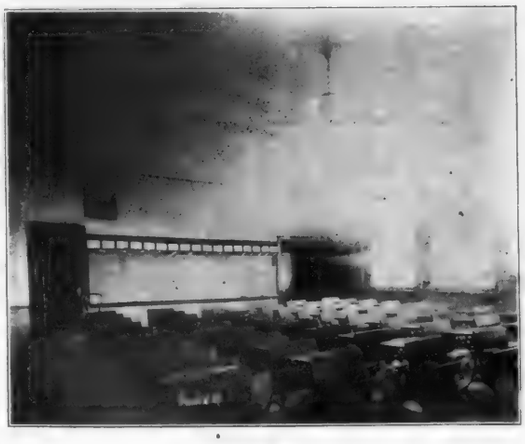


PLATE G.

VIEWS IN WASHINGTON SCHOOL AT DIFFERENT PERIODS OF TEST.

TESTS IN JACKSON SCHOOL.

The third plant to be tested was that in the Jackson school, the poorest building from a construction point of view of any of the three. While the sash had been weather-stripped to prevent air leakage, there was still some leakage around the window frames. This plant was of the unit type, as described in the first part of this article. The room selected was in the northwest corner, and the tests were made at the same time of day as the others.

Fig. 3 shows the general arrangement of the room, together with the location of the stations where the temperature readings were made and also the location of the unit machine. The volume of air supplied to this room was just 1200 cu. ft. per minute, a mean between the other two.

As noted on the sketch, (Fig. 3) the air velocity was very high, and the effect of this on the temperature readings was soon apparent. As shown by the tabulations, the maximum variation between 6 in. and 9 ft. from the floor was only 4°, and this occurred only near the windows. This was probably accounted for by the pull of the cold window surface and the subsequent chilling from the sash leakage. At no other point in the room was the variation over 2°.

In making the smoke test, the bombs were suspended over the air outlets from the machine and directly in the current of air travel. The camera was located at Station 9 and Plate I shows the arrangement before the ignition of the bombs.

Plate J was made 15 sec. after the ignition of the bombs and shows the heavy volume of smoke on the ceiling and in the upper part of the room. Plate K was made 45 sec. after Plate J and shows a fairly uniform diffusion throughout the entire room. Plate L was taken 3 min. and 15 sec. after Plate K and shows very little change.

As shown by these illustrations, the diffusion was almost immediate and within a minute after the ignition of the bombs, the cloud covered the entire room. While the body could detect no appreciable air movement, the smoke cloud was in constant motion, whirls being seen in all corners and even in the cloak space. Of course, under such conditions, stratification was impossible.

CONCLUSIONS DRAWN FROM DATA.

The foregoing data prove very conclusively that the high-velocity jet from the unit machine gives much better diffusion than the lower velocity with either the split or plenum system. This jet acts on the air in the room very largely as a stream of water through the nozzle of a garden hose acts upon a barrel of water, as opposed to the same quantity of water from the hose within the nozzle. In the first case, all the water in the barrel is agitated while in the latter, local currents are set up. While the air agitation is complete, there is not enough air movement to set up any objectionable currents.

All of the above findings are based upon performance in individual rooms, but there is another side to the question of equal importance. It is possible to theoretically design a central fan blast system so that all rooms get a like quantity of air, but the writer has yet to meet with such a system in actual practice. In the best of systems there are certain rooms that the custodian of the plant will tell you are "slower to heat" than others. In other words, they are not getting their full quota of air. In the best of construction, windows and doors will leak at times, and if there is a strong wind blowing the balance of the system is upset.

It is this difficulty in the plenum system that has led up to the split system. Anyone will immediately notice lack of heat, but lack of ventilation is not so readily detected. Therefore, put in direct radiation and the faults of your plant are more or less successfully camouflaged.

In the unit system, each machine is giving the particular room a full quota of air, regardless of exterior conditions. After the speed of the fan is once adjusted, the question of air delivery to that room is settled.

In the grade schools of St. Joseph, the primary rooms are dismissed an hour earlier than the higher ones and the heat in those rooms can be discontinued with a resulting saving in power and steam. The old central fan system in the Jackson school had a 7½ H. P. motor that had to be operated at full speed as long as a single classroom

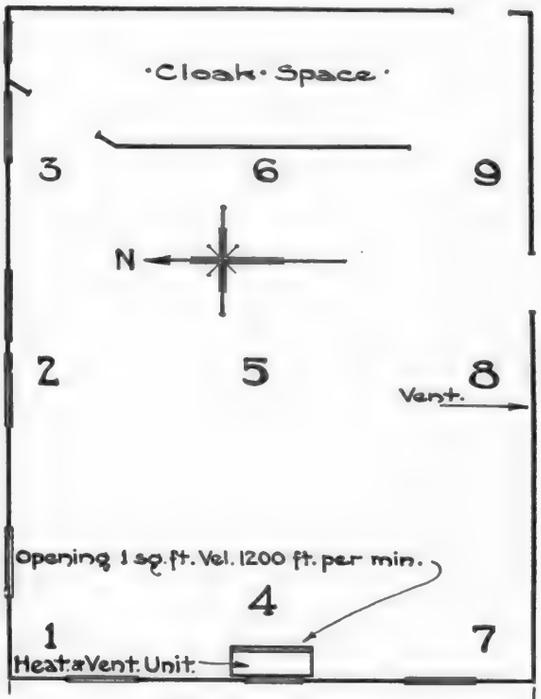


Plate 3

·Temperature · Readings·

·Station·	6 in. From Floor	5 Ft. From Floor	9 Ft. From Floor	Greatest Temperature Difference.
1	69	72	73	4
2	69	73	72	3
3	69	73	73	4
4	71	72	73	2
5	70	71	72	2
6	70	72	72	2
7	71	71	72	1
8	71	71	71	0
9	69	70	71	2

FIG. 3—TEST IN JACKSON SCHOOL.

was used. Under the unit system, there are eight motors using about 2½ amperes each at 70 volts, and any or all may be discontinued at will. The power saving is self-evident.

OPERATING COSTS.

It was rather difficult to determine the exact comparison of operating costs as all of these plants had had partial shut-downs on account of coal shortage. In both the Bliss

and Washington schools the fans are driven by steam engines at a comparatively small expense, as the exhaust steam is used for heating purposes. In the Jackson school, the power is purchased from the local lighting company and this acts against the plant in the showing of costs. In

As near as can be determined, the cost per cubic foot for heating and ventilating these buildings so far this season are: Bliss school ,$0,001005; Washington school, $0,00125; Jackson school, $0.00113.

The net result of all the above investigations and tests is

PLATE I.

PLATE J.

PLATE K.

PLATE L.

VIEWS IN JACKSON SCHOOL AT DIFFERENT PERIODS OF TEST.

a larger installation it would be possible to install a steam-driven generating unit. Another factor that should be taken into consideration is that the air leakage in the Jackson school is much greater than in either of the other two, owing to the physical condition of the building.

that in the opinion of the writer the unit system has proved so satisfactory that he has decided to recommend its use in a larger school where the present plant must be replaced.

WHY AND HOW COKE SHOULD BE USED FOR DOMESTIC HEATING

Heating engineers who have not familiarized themselves with the burning of coke in house-heating boilers will find some useful information in a technical paper (No. 242) recently published by the Bureau of Mines, detailing the bureau's experiments which are intended to demonstrate that soft coal can be prepared by conversion into smokeless fuels, coke and gas, so that all the materials in the coal are used to the best advantage. The authors of the paper are Henry Kreisinger and A. C. Fieldner.

Coke, it is stated, should be used for heating houses because it is a clean and convenient fuel. It eliminates smoke, reduces the necessity of cleaning the furnace and flues, requires less attention than coal, and gives a more uniform temperature in the house. By burning coke for domestic heating, more soft coal will be used in by-product plants, which save many valuable by-products that are wasted when the coal is used directly in the raw state. The by-products of popular interest obtained in the coking process are gas, light oils, ammonia and tar.

It may not be generally known that when one ton of soft coal is coked in a by-product plant, about 5000 cu. ft. of gas is made available for outside use. Moreover, the

process of coking one ton of soft coal yields about 3 gal. of light oils suitable for motor fuel. At present prices the heat in the light oil has about twenty times the commercial value of the same amount of heat in the form of coal.

When soft coal is burned in house-heating furnaces most of the light oil escapes unburned and is wasted. By converting the coal into coke and using coke as a house-heating fuel, the light oil obtained as a by-product helps materially to replenish the decreasing supply of motor fuel.

Again, when soft coal is burned in its raw form in any kind of furnace, the ammonia, which contains the nitrogen of the coal, escapes into the air and is wasted. It has frequently been proposed to build large hydraulic power stations to generate cheap electricity and use the electricity to obtain nitrogen from the air. "Why," ask the authors, "should soft coal be burned in a raw state, discharging all its contained nitrogen into the atmosphere, and then expensive hydraulic plants be built to get back from the atmosphere part of the nitrogen wasted in burning the raw coal?"

INCREASED VALUE OF PRODUCTS OF THE COKING PROCESS

When one ton of soft coal having a market price of $7.00 per ton is coked in a by-product plant the chief products obtained have the value shown in the following table:

TABLE 1.—VALUE OF BY-PRODUCTS OBTAINED BY COKING 1 TON OF COAL.

Cost of 1 ton of coal	$7.00
1 ton of coal produces—	
0.65 ton of coke, worth	6.00
5,000 cu. ft. of gas, worth	5.00
3 gal. motor oil, worth	.75
9 gal. tar, worth	.25
25 lbs ammonium sulphate, worth	1.25
Total value of products	13.25
Less cost of 1 ton of coal	7.00
Increased value	6.25

2. Use very little draft after the fire is started and keep it always under control.

3. Do not stir the fuel bed; clean the fire in the morning, if possible.

4. Use sized coke; ½ to 2 in. for furnaces, boilers, and stoves; ½ to 4 in. for open grates.

5. Do not allow ashes to accumulate in ash pit.

FIGURES SHOWN BY TESTS.

Results of investigations of the value of different fuels, including coke, anthracite, and soft coals of various kinds, as fuel for house-heating furnaces will be published in a separate bulletin by the Bureau of Mines. The results obtained thus far show that coke can be burned in house-heating furnaces much more efficiently than soft coal.

The results obtained with coke under a steam boiler of a size to supply 800 sq. ft. of radiation are summarized in Table 2.

TABLE 2.—RESULTS OF TESTS WITH BY-PRODUCT COKE.

Proportion of boiler capacity developed	Average peroid between firing	Duration of tests	Overall efficiency
Per cent	*Hours*	*Hours*	*Per cent*
52	4	96	73
88	4	120	72
122	3	120	63

The table shows that more than 70% of the heat in the coke was usefully employed in heating the house.

Some time ago the engineering experiment station of the University of Illinois made comparative tests of by-product coke, gas-house coke, Pocahontas coal, and Illinois coal. The results of these tests are printed in Bulletin No. 19 of the University of Illinois. Table 3 gives the summary of results of tests obtained with a boiler capable of supplying 800 sq. ft. of radiation.

This table shows that with coke about 61½% of the heat in the fuel was utilized in heating the house, whereas, with Illinois coal, only 48% of the heat was utilized. Hence if the coal and the coke contained the same amount of heat, about 7¾ tons of coke will deliver as much heat into the house as 10 tons of the soft coal. In addition to this higher efficiency from coke, the furnace and boiler room are kept clean with less work and there is no smoke to pollute the atmosphere.

TABLE 3.—RESULTS OF VARIOUS FUELS IN HOUSE-HEATING BOILERS.

(Tests made at the engineering experiment station of the University of Illinois.)

(Tests made at the engineering experiment station of the University of Illinois)

Fuel	Efficiency of boiler and furnace	Fuel fired at each firing	Average interval between firing	Rated capacity developed
	Per cent	*Pounds*	*Hours*	*Per Cent*
By-product coke	61.63	75	3.71	64.46
Gas-house coke	56.22	75	3.21	65.48
Anthracite	51.93	75	2.47	66.00
Illinois coal, Williamson County	48.00	75	2.92	64.04
Pocahontas coal	46.51	75	3.30	63.88

HOW TO BURN COKE IN HOUSE-HEATING EQUIPMENT.

The directions for burning coke can be condensed into five rules, as follows:

1. Carry a deep bed of fuel; a bed about 18 in. thick gives best results.

COAL VS. OIL PERFORMANCE CHART

BY L. C. LICHTY.

ONE of the first questions asked, when it is suggested that a change in fuel in a power plant be made, from coal to oil or vice versa, is whether it pays to make the change, or whether the cost of evaporation will go up or down. Calculations are usually made to determine the relation or relative value of the fuels in question, making use of the cost per ton of coal delivered at the plant, its heating value and the efficiency of the boiler plant when burning coal in the one case, in comparison with the results determined by making use of the density of the oil fuel, the heating value per barrel, the cost per barrel delivered and the efficiency when burning fuel.

Everything except the efficiency when burning either one or the other fuel is known. In burning coal the efficiency obtained is known while it is problematical just what the efficiency will be when changed to oil burning. With large boilers, properly equipped with well-designed furnaces and burners it is possible to obtain an efficiency of 82%. This of course, will not ordinarily be obtained under actual operating conditions, but during test conditions, when the operation is carefully watched. Poor furnace conditions and operation will reduce the efficiency of an oil-burning plant lower than if coal were used. So it can be said that under favorable conditions a higher efficiency can be obtained when burning oil than coal, but it is unlikely in average plant operation that the efficiency when burning oil will be greater than while burning coal.

However, the matter of efficiency is one for each plant operator to decide for himself as he is the one who knows what the conditions are in his plant, and consequently can best say what efficiency may be expected. In making use of the accompanying chart it is left to the operator himself to decide what efficiency he will get when changing from one fuel to the other.

To make use of the chart, first determine the B. T. U. per barrel of the oil in question from the density-heat content chart. Then referring to the coal vs. oil chart, start at the cost per ton of coal and follow a horizontal line until an intersection is made with the B. T. U. per pound of coal; then follow a vertical line until intersecting the line representing the efficiency when burning coal; from this point proceed to the left and the cost of evaporating 1000 lbs. of water from and at 212° F. will be found. Proceed still further to the left until intersecting the line representing the efficiency when burning oil; then follow a vertical line up until the curve representing the B. T. U. per barrel is reached; then follow a horizontal line to the right to the vertical line through the middle of the chart and the cost per barrel of oil will be found, which equals the cost of the performance using coal.

If the cost of oil is less than determined by the chart

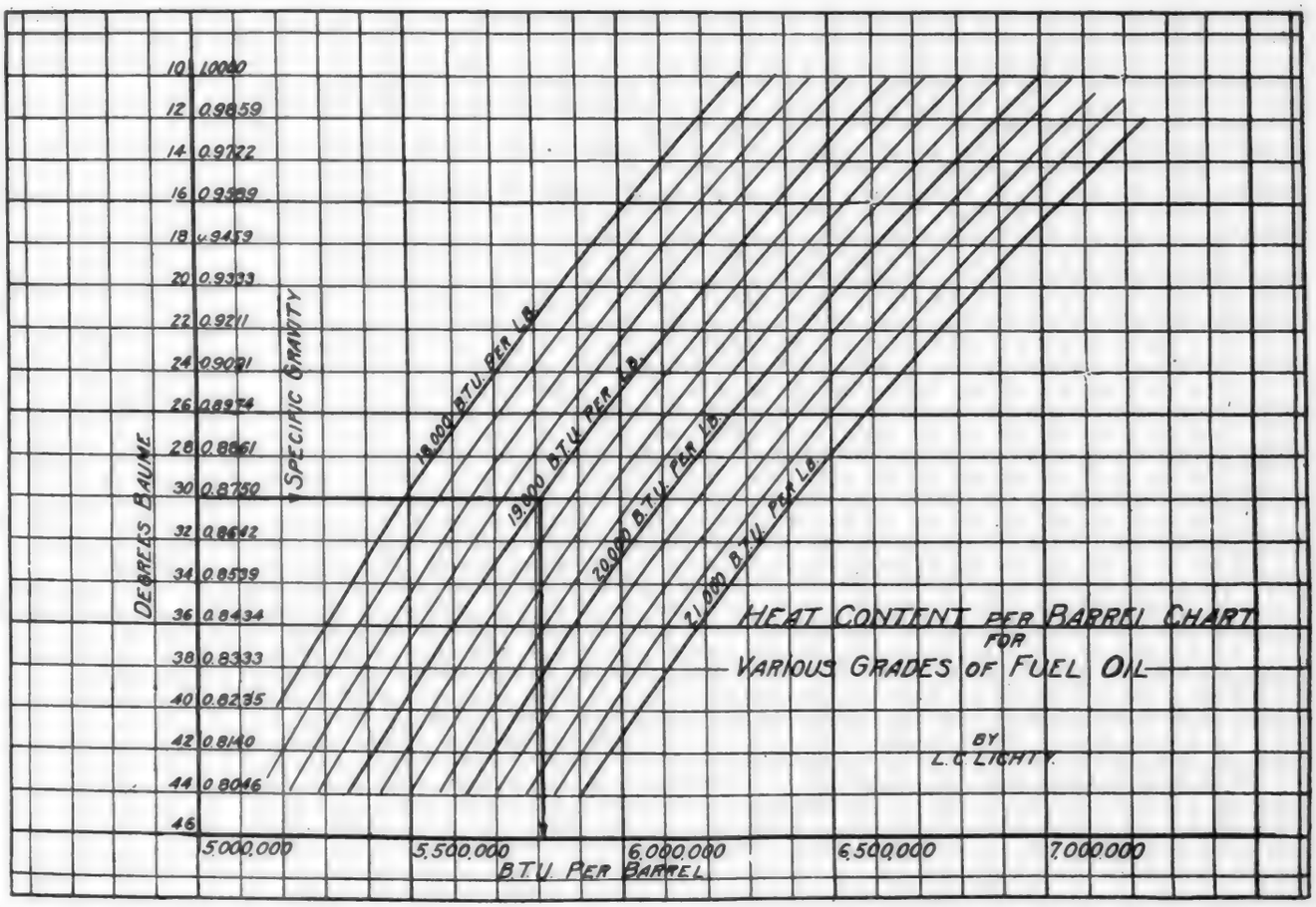


FIG. 1—CHART SHOWING HEAT CONTENT PER BARREL FOR VARIOUS GRADES OF FUEL OIL.

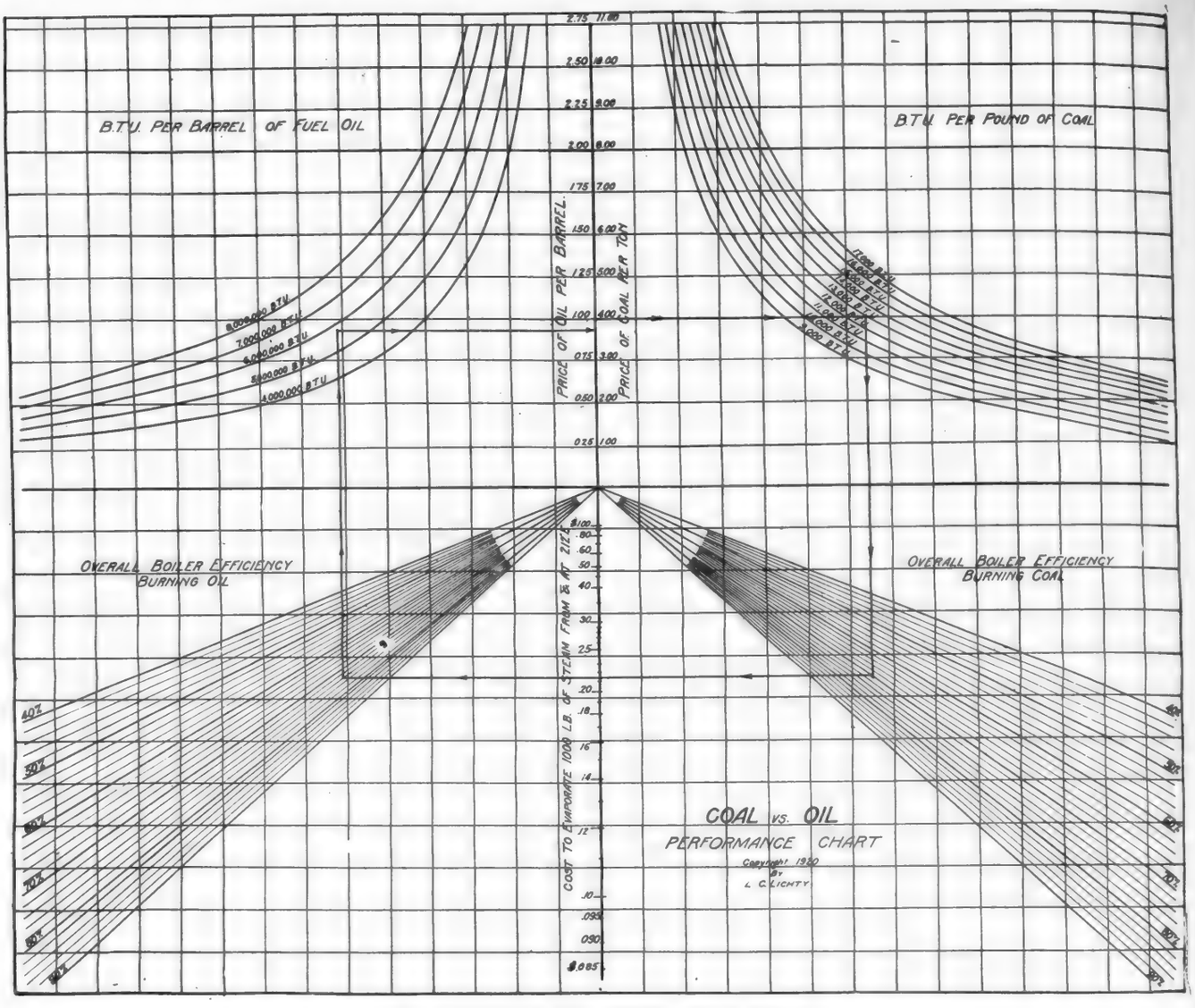

B.T.U. PER BARREL OF FUEL OIL
B.T.U. PER POUND OF COAL
PRICE OF OIL PER BARREL.
PRICE OF COAL PER TON
OVERALL BOILER EFFICIENCY BURNING OIL
OVERALL BOILER EFFICIENCY BURNING COAL
COST TO EVAPORATE 1000 LB. OF STEAM FROM & AT 212°
COAL VS. OIL
PERFORMANCE CHART
Copyright 1920 by L. C. LICHTY

FIG. 2—COAL VS. OIL PERFORMANCE CHART.

in the above manner it will pay to change to oil (not considering anything but cost of the fuel).

If burning oil, tracing lines around the chart in the opposite manner starting with the cost per barrel of fuel and ending with the cost per ton of coal, will show what price coal is equivalent to the oil being used.

PLAIN TALK ON CENTRAL STATION HEATING RATES

BY D. D. HAYWARD,

Western Manager, American District Steam Company.

The rates charged for steam heating service have not increased in proportion to the cost of distribution, nor have the rates for steam service been increased in any percentage comparable with the increase cost of the individual boiler plant. One outstanding reason for the low rates for steam service when higher rates could be procured is the lack of knowledge, upon the part of the operating company, as to the proper method of analysis upon which rates for steam service are founded.

Contrary to analysis, the writer found on his desk one morning recently a letter from which he quotes:

> "The town in the adjoining county charges a rate of 70 cents per thousand pounds of steam and we believe we will notify our customers that our rate will be the same, during the next season."

For no reason, the "rate will be the same as another plant," when, as a matter of fact, the operating conditions are in no way alike; the equipment is as different as conditions can possibly be; in the one plant coal is hauled by wagon, in the other it is delivered on track into bunkers and by gravity to furnaces; countless other conditions are different yet, "the rate for steam service is to be the same."

It argues that inattention to rates, operation, load and equipment is at fault when a heating plant does not now, in this day of meters, pay profits equal to or exceeding the profit which is derived from other operating utilities.

Absolutely no service is as essential to life and the pursuit of happiness as heat.

RATES IN NEARBY CITIES ARE NO CRITERION.

One reason for the low heating rates of to-day is the fact that we compare our rates with rates in force in some nearby city and we all wait for some one else to take the lead for increased rates. To my knowledge I know of rates in force to-day that were in force in 1910 when fuel was purchased for eighty cents a ton at the mine. No increase has been made on account of surrounding rates. Every property has its own local conditions which govern its cost of service and to make a comparison of rates one should compare the cost of fuel, heat units of fuel, average boiler efficiency, boiler-room labor cost per ton of fuel burned, pounds of steam sold per dollar invested. Some heating properties are far from being "loaded" when the available business is studied, although they may be loaded to capacity of mains. This shows that extensions have been made without proper effort being put forth to "load" the first investment.

QUALIFICATIONS FOR RATE MAKING.

Rate-making for utility companies, with several departments, requires the services and uninterrupted attention of one acquainted not only with engineering and valuations, but with accounting; for the proper allocations of expense between different departments is important, as some one department may now be carrying the burden of another, and in order to secure the proper rate for "each kind of service," such service should carry its own expense.

As for central heating service it is not suicidal for a utility to demand a rate which will produce a fair return. One can always secure a rate equal to the heat unit cost of coal for the individual boiler and when it is revealed that the coal cost is but 60% of the heating cost it is easy to secure the business.

CUSTOMERS SHOULD NOT BE TOLD THEY CAN SAVE MONEY WITH CENTRAL STATION SERVICE.

In soliciting heating business it is unwise to tell your prospective customer that you can save him money for then he will be more wasteful of the heat than he would be with his own, for he is willing to spend for the heat what it has cost him in the past. Assuming that the individual heating boiler will average 25% efficient and knowing the tons of coal burned, it is an easy matter to estimate the pounds of steam secured from the coal. Apply your rate to that consumption and compare the cost with that coal cost. You will be surprised at the rate you may charge to equal that heat unit cost of coal.

CONDITIONS SHOULD BE ANALYZED BEFORE DETERMINING RATE.

Before determining the rate to be charged for heating, make an analysis, and before concluding the recommendation for rate, avail yourself of the inexpensive counsel of qualified engineers who will pass upon a rate, when operative, will return you profits equal to or in excess of other utilities. Such rate, based upon the proper fundamentals of rate building, will forever establish you in the procedure which will be approved by commissions, councils or other governing bodies. Heating plants do not fail—usually it is the management.

THE ADVANCE OF GAS FUEL IN THE HEATING INDUSTRY

With Notes on Methods of Computation, Design and Installation that are Making Gas a Rival of Coal

I.

BY DAVID H. CUYLER

FOR the benefit of those who may not know of the advances that have been made in the use of artificial gas as a fuel for heating purposes this paper, and others that will follow, are written. It is not prudent nor profitable that any of us allow prejudice, or an erstwhile lack of information to govern a final judgment concerning matters that may possibly return to our attention in a panoply of strength that may set us all a-wondering.

We all have various opinions regarding this or other interesting subjects. It will be well if we soften these opinions at times with the leaven of mature thought. The purpose of this paper is to stir up the quiet pool where the satisfied are apt to idle away the hours while a busy world is moulding its progress. We may preface our inquiry by asking, are we again listening to the great voice of humanity, calling for something that is more in keeping with the times, than the dirty, laborious methods we are slaves to where coal and the resultant ash pile is concerned?

The matter cannot be dismissed with a mere conclusion that "the public cannot afford to burn gas as a fuel for heating purposes." The fact is that goodly numbers of this same public are doing so at the present time. And again this faulty reasoning receives an everlasting rebuke when we consider that the public always has been, and always will be, willing to pay more for what can be demonstrated to be of a nature that uill add to its comfort, happiness and general well-being.

But maybe the principal argument in favor of a substitute fuel is the fact that anthracite coal is soon to become a luxury, and beyond the reach of many of us, and the trend of this industry does not inspire a degree of confidence that it ever will again be the cheap or moderate-priced fuel that it has been in the past.

We have then established a sane reason for a more or less casual study of the subject of gas as a substitute fuel, not as a price competitor of hard coal, but rather as a fuel that is going to be recognized as more modern in efficiency, utility and healthfulness.

IMPORTANCE OF USING B. T. U. METHOD OF RATING.

Gas-fuel has been successfully adopted in many sections of the country where the natural product is plentiful, but we are concerned here with manufactured or artificial gas, used under the higher rate schedules that are usual in urban localities. City gas has, up to the present time, been rated almost entirely on its candle-power efficiency,

as its principal use in the past has been for illuminating purposes, but the present wide use of the gas cooking range; of gas-fired water heaters, gas-heated laundry equipment, and now the growing demand for gas as a house-warming medium, has caused a general trend towards the adoption of the B. T. U. method of rating. What the gas-appliance industry will have to challenge is the inclination of the gas manufacturing industry to seek lawful authority to produce and market a product that is so low in heat unit efficiency that the economical operation of many devices will be impossible.

All who have followed the articles published from time to time in the engineering journals have noted many individual cases where gas has been successfully adopted for furnishing steam or hot water to radiating surfaces. We desire here to treat of methods of computation, design and installation work, as it will be found that the heating profession will be called upon more and more in the future to consider these problems from the practical standpoint.

COMPARATIVE REQUIREMENTS OF GAS-FIRED AND COAL-FIRED HEATING SYSTEMS.

Readers of THE HEATING AND VENTILATING MAGAZINE have knowledge or ready means for computing the radiation requirements for any building under construction. With gas-fired apparatus the problems for computing the requirements, design and extent of any heating plant are identical with cases where coal is to be used as the fuel, in-so-far as the radiation and piping to the heat-generating apparatus is concerned. We have then to consider methods for computing a heating unit where gas is to be used as a fuel.

WIDE DISCREPANCIES IN GAS RATINGS.

Those engineers who have interested themselves in this matter of the modern demand for substitute fuels have learned by sad experience to weigh well the cost of a too great dependence on a high efficiency gas rating as passed out by the gas company's engineers. These heat unit efficiencies run a wide margin, anywhere from 450 B. T. U. per cubic foot to 600 B. T. U. or more, but for safety's sake, in making computations we adhere to a standard of 520 B. T. U. per cubic foot of gas, and that rating has proved to be conservative, except in known cases of lower ratings.

DETERMINING SIZE OF HEATER UNIT REQUIRED.

In deciding the size of heater unit required for work of any magnitude, we have first to know the sum total of the radiating surfaces to be supplied. To make the matter more understandable, we will consider a house in which our heat-loss computations have resulted in a total radiation requirement of 600 sq. ft. of cast-iron direct radiation, and to this we must add a 30% allowance for uncovered piping, thus making a total of 780 sq. ft. We have now to determine how many cubic feet of gas we will have to burn per hour at peak load demand, for that should be the basic principle that will govern the size of equipment. We will consider the problem both for steam and water heating surfaces.

STANDARD RADIATION EFFICIENCY FACTOR RECOMMENDED.

We us a standard radiation efficiency factor of 250 B. T. U. per square foot for steam and 150 B. T. U. for hot water, so multiplying the 780 sq. ft. by 250 for steam and by 150 for hot water we have a total of 195,000 B. T. U. per hour in the case of the steam radiation and of 117,000 B. T. U. per hour for a water heating system of an equal amount of radiation. We should then determine the B. T. U. rating of the gas that will be burned to do the work, but for our problem, we will use the standard of 520 B. T. U. per cubic foot. If we then merely divide the total B. T. U. requirements, as given above, by this figure, we find that for the steam radiation we will have to provide burners and equipment that will supply and transmit 375 cu. ft. of gas per hour for the steam radiation, and 225 cu. ft. for the water radiation. To this we must add at least 15% for losses, as the gas-fired boilers that are in general use have an efficiency that is conservatively stated to be 85% when properly controlled and operated.

THERMOSTATIC CONTROL A NECESSARY ADJUNCT.

In a later article we will present the various types of gas-fired heating equipment, with such information concerning them as is obtainable. The use of gas-fuel for heating purposes has removed thermostatic control apparatus from the luxury class, and has placed it for once where it is a very real essential, for it is beyond all doubt, unwise and foolish to install gas-burning heating equipment without it. Gas is an expensive fuel when wasted, far more so, than any other fuel, and therefore every possible means for the prevention of waste should be adopted. The above mentioned computations showing a gas requirement of 375 and 225 cu. ft. per hour should not frighten the uninitiated. These figures are the basis for determining the burner and transmission equipment for a peak load demand.

PRESENT COST OF GAS HEATING.

The American Gas Association has computed the total hours for heating demand in accordance with the following schedule:

Up to October 31	259 hours.
Oct. 31 to Nov. 30	519 hours.
Nov. 30 to Dec. 31	778 hours.
Dec. 31 to Jan. 31	908 hours.
Jan. 31 to Feb. 28	821 hours.
Feb. 28 to Mar. 31	562 hours.
Mar. 31 to Apr. 30	346 hours.
Apr. 30 to May 15	130 hours.

This shows a total of 4323 hours for the heating season and practice has proved that the cost of gas-fuel at the rate of $1.00 per 1000 cu. ft. will run about 6½ cents per hour, or about 0.36 cents per square foot of water radiation per heating season. The cost of gas-fuel for steam radiation, even where the total square feet of surface is lower than would be required for a water heating system, will run higher owing to the fact that a water heating system will lend itself to a more perfect automatic regulation. On this account the water heating system is generally advised where gas-fuel is to be used.

HIGH EFFICIENCY THE KEY TO SUCCESS IN GAS-HEATING SYSTEMS.

We are making long strides along the road to success, and high efficiency is the only thing that stands for success to the gas heating engineer. We know for certain that something must take the place of coal; oil is to bulky and troublesome for ordinary use; electricity is out of the question from the point of economy, what then have we to do but to combine our interests and see just what we can do with this gas problem.

Sulphur Dioxide as a Factor in the Smoke Problem of Salt Lake City.

A fairly widspread opinion exists in Salt Lake City that the smelters in that vicinity contribute appreciably to the smoke nuisance. The gases discharged from the smelter stacks are believed to float over the city in a heavy blanket which prevents the smoke from rising and to unite with the water vapor in the air to form corrosive fogs injurious to health and property.

As a result of the agitation, the United States Bureau of Mines has been co-operating with the State of Utah and Salt Lake City in an investigation of methods of abating the smoke nuisance in Salt Lake City. Samples of the air have been analyzed to determine the part played by sulphur dioxide or some smelter gases in polluting the air at Salt Lake City.

Regarding the theory that the smelter gases float over the city, the report of the Bureau, prepared by G. St. John Perrott, physical organic chemist, states that this seems untenable. If the gas did not mix with air it would sink, owing to its heavier specific gravity, and form a blanket on the earth. Actually, the gas diffuses rapidly in the air and any part reaching Salt Lake City must be thoroughly diluted. Perhaps sulphur dioxide in sufficient concentration might aid in fog formation. The more obvious nuisance, however, would be the injury to health and vegetation.

Sulphur dioxide, continues the report, is a colorless gas with a pungent odor and acid taste. In sufficient concentration it is injurious to animal life and vegetation. It is 2.2 times as heavy as air, but it diffuses readily with air and when once mixed does not again separate.

Extensive experiments have shown that concentrations of sulphur dioxide below 0.5 parts per million have no injurious effects on growing crops or vegetation. For injury to result with this concentration, continuous exposure throughout the growing period would be needed, together with a high relative humidity of from 80% to 100%. A concentration of 3 parts per million is necessary before the average individual can detect its presence. Evidently the average concentration of sulphur dioxide in air must rise to 0.5 or 1 parts per million before it can be considered an important factor in the pollution.

The nearest smelter is 8 miles from the city while two others are located 12 miles and 16 miles away, respectively. From the data obtained, which included some 322 determinations the conclusions were reached that:

RESULTS OF TESTS OF AIR IN BUSINESS AND RESIDENCE DISTRICTS.

1. The concentration of sulphur dioxide after 12 noon is usually smaller than 0.1 parts per million, the greatest concentrations occur before 10 a. m.

2. The highest concentration is observed in the business district.

3. Smoky days show higher concentrations than clear days.

4. There is an inverse relation between wind velocity and concentration of sulphur dioxide but no apparent relation between the direction of the wind and the sulphur dioxide concentration.

5. The average concentration during December and January was about 0.15 parts per million, during March about 0.01 parts per million.

The data go to show that the sulphur dioxide in the air of Salt Lake City is largely a result of the combustion of fuel. At least 15 tons of this gas are sent into the atmosphere daily from the stacks of the city. The concentrations observed seem to bear a definite relation to the amount of smoke present

The concentration of sulphur dioxide was at no time large enough to be an important factor in polluting the atmosphere of the city, and is less than that observed in other large cities. As high as 6 parts per million has been observed in London, 0.5 to 0.7 parts in Berlin, and 1.08 parts in San Francisco.

The concentration of SO_2 in Salt Lake City diminshes practically to zero in the residence districts on all sides of the business district. If the smelters were a factor, the concentration should be higher to the south and west; such is not the case.

TESTS AT HIGHER LEVELS.

To test the theory that a blanket of sulphur dioxide gas existed over the city, analyses of the upper strata of the atmosphere were made from an aeroplane.

The data collected are meager, but they serve to show that no heavy blanket of sulphur dioxide of high concentration was hanging over the city on November 9 at any level below 3000 ft. The day was typically smoky, and undoubtedly conditions were not radically different from any other smoky day in winter.

Lives Six Days in a Sealed Glass Case.

Heating engineers will be interested in a daring experiment which has just been carried out by a middle-aged British university professor, Joseph Barcroft, F. R. S., reader in physiology at Cambridge University. The test was made in the interest of aviation and the question involved was whether it would be possible to calculate the quantity of oxygen necessary to an airman at high altitudes. To determine this, Professor Barcroft offered to permit himself to be sealed in an air-tight glass case for a period of six days.

The case in which Professor Barcroft was shut up for six days was specially erected in a quiet room in the physiological laboratory. It was about 7 ft. high and about 10 ft. broad. The floor, walls and roofs were made of glass, hermetically sealed, and divided into two compartments—one fitted with a lounge chair and table and the other with a simple bed.

At the foot of the bed was a pedaling apparatus consisting of the frame of a bicycle, from which the front wheel had been removed, and a small black wheel with a frame attached, to enable Professor Barcroft to get some exercise and cause a certain amount of work to be done.

During his six days in this case Professor Barcroft spent his time in work relating to the experiments, in taking exercise on the bicycle and in sleeping. He was kept under observation day and night to insure his personal safety, college students and others taking it in turn to keep watch.

Nitrogen was continually introduced into the chamber and the air became gradually rarer in oxygen until it approximated that at an altitude of 16,000 ft., when Professor Barcroft, who has had experience of mountaineering, experienced considerable inconvenience from sickness and sleeplessness, and also an indisposition to take any food.

At the close of the experiment some blood was taken from Professor Barcroft's arm. The oxygen the blood contained was separated and it was found to agree with the expectations of the experiment.

Professor Barcroft confesses to having felt rather shaken up after his release from the glass case, but did not look much the worse for the experience.

The experiment is regarded in England as thoroughly successful and a scientific report of it will be laid before the next meeting of the British Association, in which Professor Barcroft is president of the physiological section.

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IN THE light of recent events, nothing could be more opportune than the appearance at this time of our Fifth Annual Fuel Conservation Number. The fact is that during the past few years every early Fall season has witnessed a coal crisis and although each crisis has been met in one way or another, it has left its impression which is now beginning to sink deep into the minds of all concerned. Those, for instance, who have lightly dismissed the idea that we might have to abandon the use of anthracite in heating work and who have pointed to the vast supply of hard coal still available, are finding much food for thought in the present anthracite prices. It seems to be realized only now by many that long before any real scarcity of anthracite occurs, the cost will run to unheard-of heights and will make its use altogether prohibitive on present lines. Nor does it take more than ordinary acumen to realize that even bituminous coal cannot be used indefinitely in its raw state, not on the ground of scarcity, but due to its valuable by-products which make the present methods of burning soft coal for heating purposes a sheer economic waste.

The growing use of soft coal in heating plants is reflected very clearly in the continued development of the smokeless boiler principle. Each year sees additions to the standard designs, while the growth in the number of such units installed is reaching impressive figures.

As to other fuels than coal, the fuel-oil sensation, which startled the East last Fall with its interesting possibilities, is by no means a closed incident. Engineers are following a policy of "watchful waiting" in this connection and this is singularly appropriate since the key to the difficulty lies in Mexico. Until Mexican affairs are better ordered than they are at the present time, there is little likelihood of fuel-oil becoming a commercial rival of coal, at least in the East.

Viewing the lack of fuel conservation from the standpoint of operating economies, no doubt this is an evil we shall always have with us. It is a significant thing, however, that after all the programs of fuel conservation that have been outlined and brought to the attention of plant managers, it can be said by an authority who has had the experience of David Moffat Myers that "if all well-known and well-tried methods of fuel conservation were put into effect throughout the United States, the resultant saving would amount to 75,000,000 to 100,000,000 tons per year in coal alone, without reference to the saving which would be effected in the use of other fuels."

Coming down to particulars, Mr. Myers, who was in charge of the engineering department of the United States Fuel Administration, points to the fact that during the war, owing to very obvious reasons, it was impossible to secure new or improved power plant equipment for the purposes of saving fuel. For that reason the Fuel Administration in its campaign had to use the equipment which was found in the plants and still produce large savings of fuel. As many plants will still face this condition for some time to come it is in order to mention again the recommendations that were applied:

That fuel be weighed and recorded; that water fed to boilers be heated by exhaust steam, measured and regulated; that proper regulation of air supply be established by simple methods, which were explained; that boiler heating surfaces be kept clean inside and outside; that boiler settings and furnaces be made and kept free from air leakage; that furnaces, grates and settings be kept in good repair; that the surfaces of steam piping, drums and feed-water heaters, which waste heat by radiation, be covered with insulating material; that exhaust steam be utilized wherever possible, instead of direct steam from the boilers; that the plant should be operated in such a manner that, as far as possible, no more exhaust steam would be produced than could be utilized for heating and process work; and, finally, that proper supervision of the plant and its departments be established and maintained by means which were recommended.

Answering the question as to where this waste exists, Mr. Myers makes the pointed answer of "Everywhere." How fuel is wasted in the use of steam, after its generation, is summarized in the reference to inefficient types of prime movers, careless maintenance of engines and pumps, ill-advised installations unsuited to the purpose they would fulfill, huge volumes of wasted exhaust steam expelled to the atmosphere, the unnecessary use of live steam where exhaust steam, with proper engineering, would fully meet the requirements, and badly designed and ill-kept transmission systems.

Surely in eliminating these wastes we have a project worthy of a master effort and one in which we are proud to participate in this present Fuel Conservation Number.

FUEL-SAVING WRINKLES

Comparative Fuel Economies Effected by Automatic Temperature Regulation and Manual Control With Divided Radiation.

It is desirable that the radiation in a room be arranged in units in such proportions that the heating surface can be varied to suit the outside temperature. In large rooms this is accomplished by equal division of the radiating surface into units, one of which is placed at each window, an arrangement which makes it possible to shut off any number of radiators as desired in mild weather. Similar results are obtained in small rooms with only one radiator by dividing the radiator into two sections, each of which is valved and connected to a riser as shown in Fig. 1.

Fig. 2 shows how this method of divided radiation may

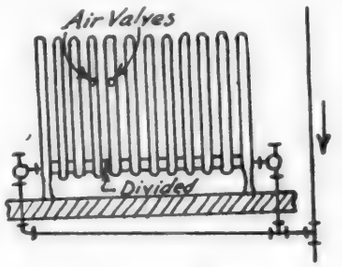


FIG. 1—METHOD OF DIVIDING RADIATION INTO FLEXIBLE UNITS FOR REGULATION OF TEMPERATURE.

be accomplished in the case of pipe coils, the effect as in Fig. 1 being that of two units, whereas the appearance is that of one. One unit is made twice the size of the other so that one-third, two-thirds or three-thirds of the total radiation may be placed in service as required. The divided pipe coil can be used in a two-pipe system, but the divided radiator can be used only in a one-pipe system.

The matter of divided radiation suggests the possible economies which may be effected through the application of the various appliances which enter into the field of auto-

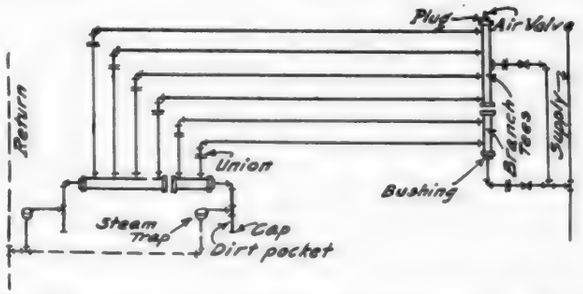


FIG. 2—METHOD OF DIVIDING PIPE COIL INTO PROPORTIONATE UNITS FOR MANUAL CONTROL.

matic temperature regulation. While it may be possible to approximately proportion the radiation in units to suit the heating requirements with varying degrees of outside temperature, it is seldom that the proper attention is given to the manipulation of the radiator valves so that open windows are more usually the result of this practice. Rooms should be cooled by turning off the heat rather than by opening windows,—so far as this method is consistent with adequate ventilation. Consequently, temperature control makes for economy of fuel, since the heat supply is automatically (not manually) controlled. Whenever the desired temperature has been attained, the heat supply is automatically shut off, to be turned on again only when the temperature drops below the desired point.

Heating systems are designed for the maximum load which occurs when the weather outside is the coldest. In this latitude it is below zero less than 10% of the heating system. Consequently, the heating system must be run during the remainder of the heating season at less than full capacity, so that there is a tendency to overheat in milder weather in all classes of buildings unless devices for temperature control are installed.

Utilizing the Waste Heat of the Open Fireplace.

The large amount of waste heat which ordinarily passes up the chimney from an open fireplace may be partially reclaimed for the heating of large rooms by means of the scheme shown in the accompanying sketch, an enclosed duct of sheet metal being placed on each side of the fireplace so as to receive the radiation from the fire. Inasmuch as the fireplace mantles in hotels and in club rooms are usually set at such a height that circulation

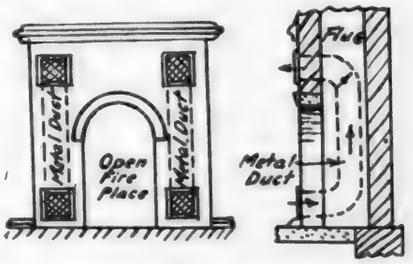


FIG. 1—SCHEME FOR UTILIZING WASTE HEAT FROM FIREPLACE.

within the ducts will be created by the difference in temperature of the air at the two levels, colder air will enter the lower register and being warmed will rise and return to the room through the upper register.

Conservation of Hot Drips and Their Value As Compared With Exhaust Steam.

Although the value of exhaust steam, compared to that of the hot returns, is often misunderstood and conservation should begin with the exhaust steam, the matter of hot drips should also be attended to since these save distilled water and fuel and reduce the amount of scale deposited in the boilers. The relative importance in the saving of exhaust steam and condensation should, of course, be kept constantly in mind, remembering always that weight for weight, the saving in the return of hot drips is only one-fifth that obtained through the use of exhaust steam. It is not good practice to correct the losses due to escaping drips if at the same time exhaust steam is allowed to waste to atmosphere. Water at 212° contains only 180 heat units above 32° while steam at this temperature contains 1150 heat units, of which 970 heat

units are given up as latent heat by the radiator, leaving the balance of 180 heat units in the condensate.

METHODS OF CONSERVING RE-EVAPORATION FROM HIGH-PRESSURE CONDENSATE WHEN DISCHARGED INTO LOW-PRESSURE LINES.

Radiation supplied by high-pressure steam is sometimes drained by means of traps which discharge the condensation directly into a vacuum return line. Inasmuch as a considerable quantity of this condensation is at the temperature of high-pressure steam, it will re-evaporate upon liberation in the partial vacuum. It is possible, however, by means of the arrangement shown in Fig. 1 to make use of the re-evaporated steam for use in the low-pressure mains of the heating system and thus prevent it from being wasted through some vent pipe of the plant.

A similar source of loss also occurs where low and high-pressure lines are drained through traps to an atmospheric receiver. In this case, as shown in Fig. 2, a vent connected from the receiver into the low-pressure steam main will permit the re-evaporated steam main to be used in the heating mains. This method also eliminates difficulties arising from steam in the receiver and reduces the back-pressure tending to retard the operation of certain traps in the group.

CALCULATIONS TO SHOW THE HEAT LOST BY CONDENSATION RE-EVAPORATING UNDER CONDITIONS OF LOWER PRESSURE.

Myers, in "Factory Power Plants" calculates the amount and percentage of heat lost by re-evaporation as per the following example:

Assume pressure of steam in radiator, 20-lbs. gauge.

Then temperature of steam and water in radiator equals 259° F.

If the discharge of condensation is to atmospheric pressure at a temperature of 212° the hot water discharge from the radiator will give up heat by evaporation until its remaining portion is cooled to 212°.

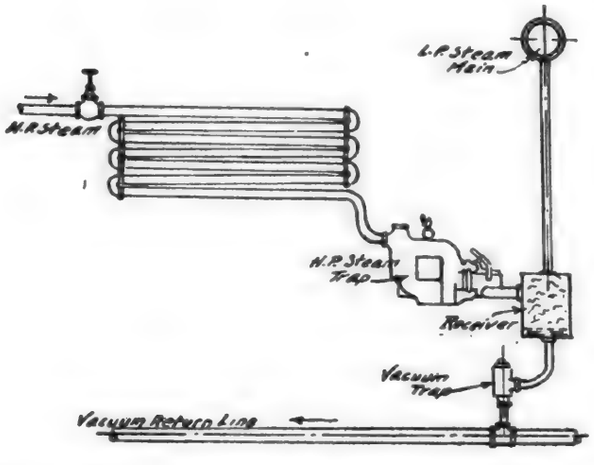


FIG. 1—METHOD OF CONSERVING STEAM RE-EVAPORATED FROM HIGH-PRESSURE PIPE COIL FOR USE IN LOW-PRESSURE HEATING MAIN.

Heat in 1 lb. steam at 20-lb. gauge.1,167 B. T. U. above 32°
Heat in 1 lb. water at 259°.....228 B. T. U. above 32°
Heat in 1 lb. water at 212°.....180 B. T. U. above 32°
Heat in 1 lb. water steam at 212°..1,150 B. T. U. above 32°

Let X equal weight of water evaporated into steam.

Then 1—X equals weight of remaining water at 212°.

$$1{,}150X+180(1-X) = 228 \text{ and}$$

$$X = 0.0495 \text{ lbs. steam at } 212°.$$

Hence waste is $0.0495 \times 1{,}150 = 57$ B. T. U. per pound of steam fed to radiator.

This is 57 divided by 1,167, or about 0.049 of the heat in the steam supplied.

Thus, it will be seen that the amount of steam re-evaporated is equal to 57 heat units or about 5% of the total heat in the steam supplied to the radiator and the actual weight of water evaporated is also about 5% of the weight of the original steam.

THE PROPER USE OF JET WATER AT VACUUM PUMPS.

The proper use of jet water at vacuum pumps is another matter not always understood. For instance, high-pressure drips, when discharged into the vacuum return line system, re-evaporate and interfere with the operation of the vacuum pump to such an extent that excessive amounts of jet water must be discharged into the suction of this pump. This method cools the hot drips and may produce more feed water than is required, the excess water and its heat being wasted by overflowing to the sewer. A certain amount of the vapor may be condensed and the temperature of the return water lowered by passing the cold water supply to the hot-water service tanks through the coils of so-called vapor condensers.

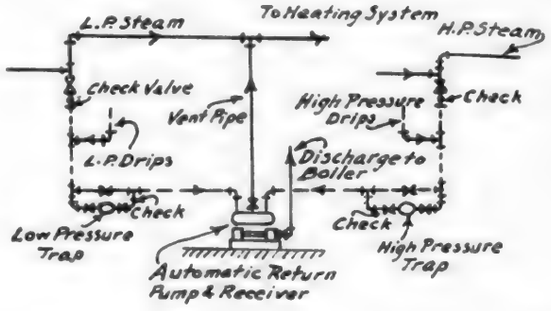


FIG. 2—ARRANGEMENT FOR USING RE-EVAPORATED STEAM IN A HEATING SYSTEM BY MEANS OF A VENT FROM RECEIVER.

In a vacuum steam heating system that requires no jet water at the vacuum pump, the air-separating tank should not be equipped with such auxiliary appliances as a float-controlled inlet and outlet valve, gage-glass, over-flow pipe and manhole. A large tank, with these appliances, is necessary only where jet water is used, because the operator may use more jet water than is required for boiler-feed, causing it to flow through the heater into the sewer. This would tax the heater beyond its proper capacity and reduce the temperature of the boiler feed. Therefore an automatic valve is placed between the tank and heater, so that the tank will overflow to the sewer and not flood the heater when excessive jet water is used.

VENTS AND THEIR SEPARATION FROM THAT OF THE BLOW-OFF TANK.

In regard to pipes serving as vents throughout the system, those from return tanks, blow-off tanks and open heaters should each extend separately through the roof; otherwise, blowing down the boilers may cause a back pressure on the other tanks. Where separate lines are impractical, check valves on each line joining the vent from the blow-off tank will prevent back pressure, but they will cause a slight resistance, due to the weight of the check. Such check valves should be so located that no condensate can accumulate above them, because it will tend to hold the valve closed and may at some time freeze.

All outlets such as those from feed-water heaters should empty into a funnel in order to make noticeable any excessive waste of water to the sewer.

VARIOUS METHODS OF CONSERVING HOT WATER.

Steam pipes that are not connected to a special drainage system should be drained whenever possible through apparatus which can handle hot water. For example, when heaters in toilet rooms have traps on their outlets intended to let water by and prevent the passage of steam, the branch from the steam line which feeds these heaters should be taken out at the botom of the steam line at such a point as to drain the line and not require a separate steam trap. The hot water returned to the water heater will contain some heat which would otherwise be lost if the drain discharged into the sewer. In the same way, reciprocating pumps may often be used to drain steam lines, because there is no objection to allowing the water to flow through the pump with the steam so long as it is a continuous operation and the water does not accumulate and come in gulps. In connection with manufacturing steam lines, it is good practice, as far as possible, to take branch lines out of the bottom of the steam header or main and let branches out of the top of the header be the exception. In this way the need of a large number of traps on headers and mains can readily be avoided.

In a manufacturing plant where it is desired to measure the condensed steam as a basis of charge for the steam used by different departments, such as drying ovens, glue pots, etc., the tilting type of steam trap may be made to serve an additional purpose. Each operation of this trap represents a certain number of pounds of condensate, so that by properly attaching counters to record the operation of the trap a continuous record of steam consumption for the line to which it is connected may be secured.

RETURN OF HEATING-SYSTEM CONDENSATION TO BOILERS.

In central heating plants there is usually a period during the morning of cold days, or occasionally at other times, when the demands for heat require the withdrawal of large volumes of steam from boilers into the heating mains

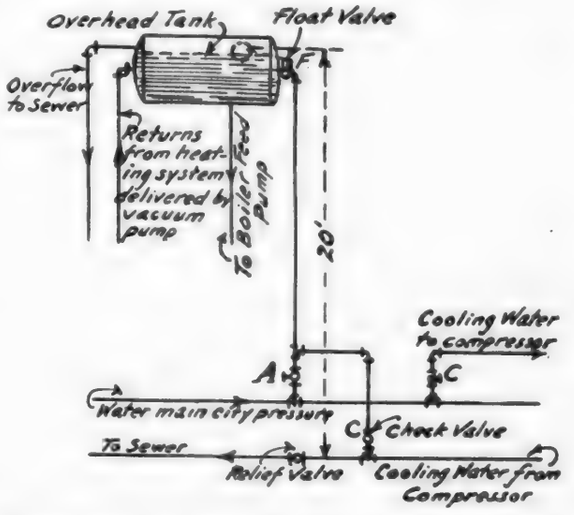


FIG. 3—METHOD OF CONSERVING COOLING WATER FOR USE IN HEATING SYSTEM.

and then to the heating system. While the first water of condensation from steam turned into a cold heating system will be returned at a rate far in excess of the later returns when the system is thoroughly heated, an hour or even more may elapse before steam returns in the form of condensate. When so returned it is pumped back into the boilers, thereby restoring the normal water-line. The result is a variable water level. This is not a serious condition when properly handled; in fact, a direct saving is possible through the return of the hot condensate to the boilers in such a way as to make the best use of the heat it contains. If a direct water-level control is applied to the boilers when steam is first withdrawn, additional water would be supplied only to be wasted upon the return of condensation from the heating system because the boiler would be full. Such a waste does not involve the water alone, but also the heat contained in the water of condensation, a more serious factor.

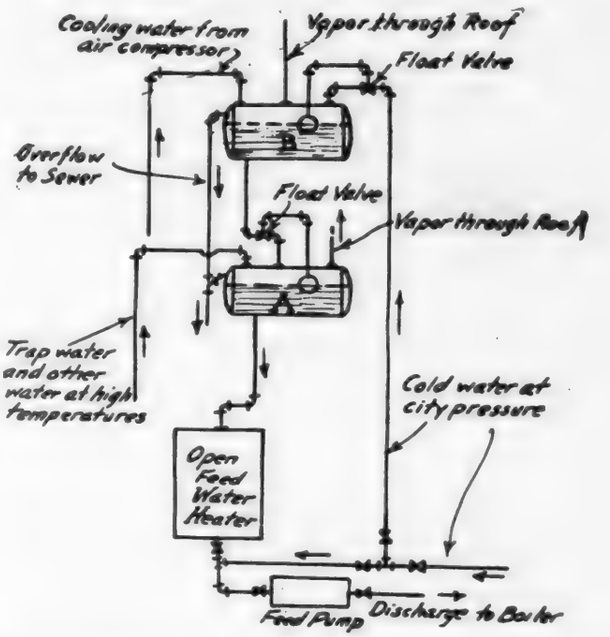


FIG. 4—DOUBLE-TANK METHOD OF SAVING AND STORING HOT WATER AT DIFFERENT TEMPERATURES.

SAVING COOLING WATER FROM THE JACKETS OF COMPRESSORS.

The cooling or jacket water from a compressor may also be saved and discharged into an overhead receiver from the heating system. If the discharge is greater in amount than the required makeup for boiler purposes, the relatively colder water from the compressor cannot be continuously discharged into the receiver without wasting part of the heat of the high-temperature heating return water by the overflow from the receiver discharged to the sewer.

A float valve cannot be installed in the discharge line to the receiver, unless provision is made by means of a relief valve for the automatic discharge of the cooling water directly to the sewer when the float valve is closed. This is a difficulty which may easily be overcome by an arrangement of piping as shown in Fig. 3, valve A being opened to admit a direct supply of city water to the receiver when the compressor is not running.

The relief valve should be so adjusted that it will open to the sewer at slightly over 10-lbs. pressure. This will allow for the static head of 20 ft. to the tank. Otherwise the water would pass through the line of least resistance, i. e., through the relief valve to the sewer, rather than raise itself to the elevated tank.

STORING HOT WATER AT DIFFERENT TEMPERATURES BY MEANS OF THE DOUBLE-TANK METHOD.

Fig. 4 illustrates another method of saving cooling water from a compressor, or the water from any other such source, together with the heat contained therein. In the operation of this installation the condensation from the high-pressure and low-pressure drips, returns from heating systems and various other sources returning water at high

temperatures to the feed-water heater, is collected by traps and dischargd into tank A. Water at colder temperatures, such as the compressor cooling water, is returned separately from the former and discharged under its own pressure into tank B.

The arrangement is such that only the hotter water is admitted to the boiler, thereby effecting a saving in heat units and avoiding unequal strains in the boiler due to expansion and contraction from varying water temperatures. The feed pumps, too, may be kept in better condition. Any excess of water will overflow from tank B, which contains the colder water. The overflow in the single-tank method will cause a loss of the hot water which is mixed with the cold, and some of the water wasted in this manner may be required a few moments later because of fluctuating demands on the boiler.

MODERN PRACTICE IN VAPOR HEATING

EDITOR'S NOTE: For the purpose of this series of articles, a vapor, vacuum, vapor-vacuum, vacuum-vapor, atmospheric, modulated or thermograde system of heating will be considered as any system in which the steam pressure ordinarily carried is practically at atmosphere or slightly below or in which the returns are open to the atmosphere and where no pump or other positive mechanical device is employed to pull back the returns.

In the description of the Illinois Vapor Heating System, published in last month's issue, through an unfortunate error, the wrong cuts were inserted to illustrate the Illinois Modulation Valve, the Illinois Thermo Trap and the Illinois Vent Seal Valve. These specialties which have a record of twenty years of successful use, are correctly shown in the following reprint of last month's article. The wide comment caused by the error has its gratifying features in showing how carefully THE HEATING AND VENTILATING MAGAZINE *is read. At the same time the publishers hasten to express their regrets and apologies to all concerned.*

The Illinois System.

The Illinois modulating or vapor system, while having all the features of the usual low-pressure modulating heating system, goes a step further in being able to operate a large portion of the time below atmospheric pressure, thus being a true vapor system, and giving the well-recognized fuel economy of a vapor system. Another unusual feature of the Illinois system is that it provides for the return of condensation to the boiler against any boiler pressure up to 10 lbs. While the returns are open to atmosphere for the discharge or venting of air from the system, the vent is sealed to prevent air pulling back into the system. The Illinois system is a combination of the essential features of both modulating and vapor systems, and of open and sealed return systems.

The piping above the basement is the standard two-pipe, a supply main with branches, risers and laterals connecting to all radiators, and a return system of piping from all radiators back to the boiler, as shown in the typical plan, Fig. 1. The supply or feed valve to each radiator is the Illinois modulating valve shown in Fig. 2. This valve requires but a half turn from full open to closed position, and a dial and indicator show the position of the valve. The valve has a machined spool with triple thread making it smooth and easy to operate, giving maximum port opening in one-half turn. In common with most systems of this class, water radiation is preferred in order to put the modulating valve at the top of the radiator for the sake of accessibility.

The return end of the radiators is equipped with the well known Illinois thermo trap, shown in Fig. 3. These traps are sensitive and prevent steam from passing into the returns, which, it is claimed by the manufacturers, keeps pressure out of the returns, and makes it possible to maintain less than atmospheric pressure or vacuum on the returns, enabling the system to circulate quickly.

The basement return mains, instead of being brought back to an air-liberating device alone, are equipped with a return receiver trap, which, in addition to liberating the air, provides a positive means for putting the water of condensation back into the boiler, against any pressure possible on the boiler—(10 lbs.). This return trap (see Fig. 1) consists of a float to actuate the rocker arms and weights which alternately open the air vent valve to permit escape of air from the system when no water is in the receiver, also to close the air valve and open the steam valve when the receiver is full of water. This puts the boiler pressure on top of the water, equalizing the boiler pressure so that the water returns to the boiler by gravity.

The importance of installing a return trap on all vapor systems which use automatic return valves on the radiators to keep steam out of the returns, is emphasized by the manufacturers, for while a damper regulator, which is also furnished with this system, will ordinarily control the boiler pressure, as is well known there are times when the pressure will run up even to 8 or 10 lbs. When this happens the return condensation is held up in the return mains and even in the lowest radiators, preventing its return to boiler until the pressure goes down, and this has resulted in many cracked boiler sections. With a proper return trap the normal operation of the system goes on, regardless of the fluctuations in boiler pressure.

The air, after leaving the return trap, passes through an Illinois vent seal valve, shown in Fig. 4 which offers no resistance to the out passage of the air but prevents air coming into the system, so that the system does not fill up with air as soon as it cools off. This not only induces vapor into the radiators from the boiler, which vapor ordinarily is not utilized, but it is not necessary to force air out of the system every time it is fired up. In this way very quick circulation is secured.

The supply mains are dripped where necessary through Thermo drip valves into the vapor return mains, but the end of a loop may be returned through either a wet or dry return direct to the boiler. If a wet return is used, an air vent valve discharging into the vapor return main is installed. This air valve is a thermostatic valve, closing against steam.

The vapor return piping, that is, the return from radiators, should be kept up as near the ceiling of the basement as possible, so as to give sufficient headroom for the return trap to be installed 6 in. or more above the water-line of the boiler.

Great flexibility may be secured with the Illinois system.

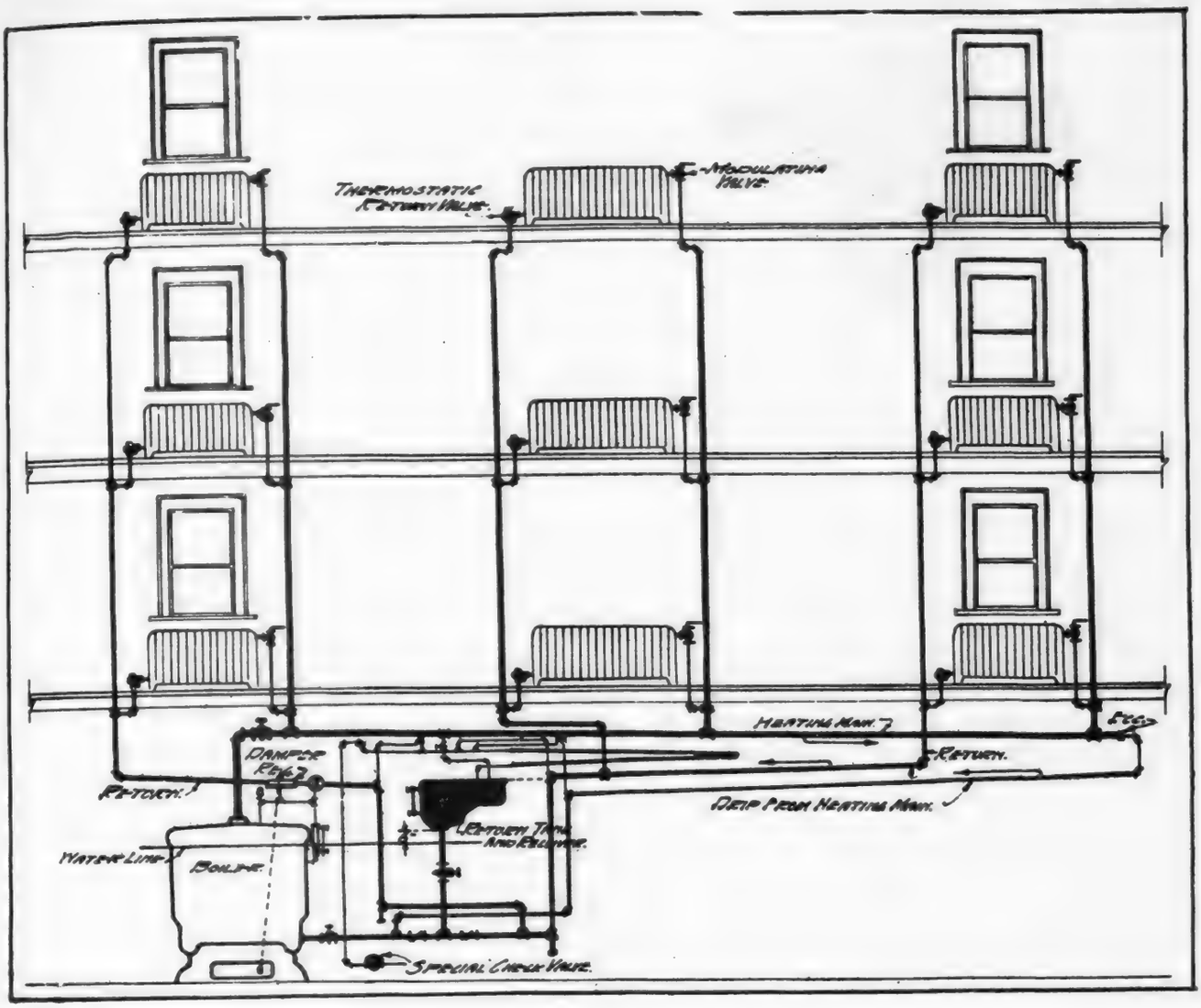


FIG. 1—TYPICAL LAYOUT OF ILLINOIS SYSTEM.

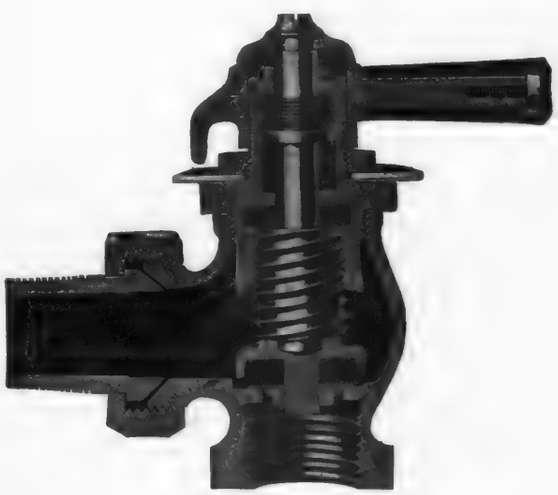


FIG. 2—ILLINOIS MODULATING VALVE.

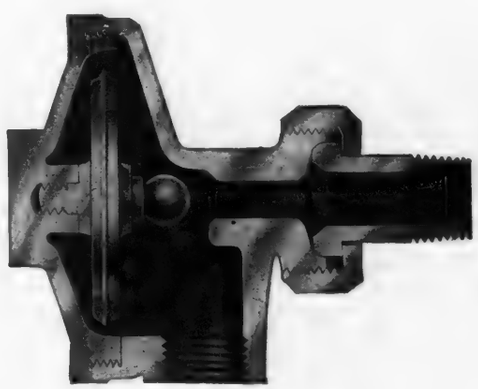


FIG. 3—ILLINOIS THERMO TRAP.

It has been installed in a variety of buildings, from residences to 17-story buildings, and in others having hundreds of radiators. In each type of installation the circulation has been found to be as rapid as though a vacuum pump was installed, and remarkable economy secured from operation under vapor conditions—below atmospheric pressure. There are also combination jobs installed where some of the basement radiation was placed below the boiler water-line and condensation pumps used to handle the returns from the low radiation, the balance of the building being handled as previously described.

FIG. 4—ILLINOIS VENT SEAL VALVE.

The Illinois system specialties used are manufactured by the Illinois Engineering Company, Chicago, Ill., which has the reputation of being pioneers and originators in this field. While many of the essential features are patented, Illinois systems are sold without royalty charges.

XXVI—The Crescent Economic System.

A system of vapor heating which has been developed in connection with central station heating work, but which is also adapted for plants with individual boilers, is manufactured by W. H. Pearce & Co., Chicago, Ill. (See Fig. 1) It is primarily the outgrowth of the demand of central station operation for a simple, inexpensive system of building heating which will do away with air valves and traps and conserve wasted heat.

The accompanying illustration (Fig. 2) shows how this system may be adapted to buildings having their own boilers by changing the piping in the manner indicated.

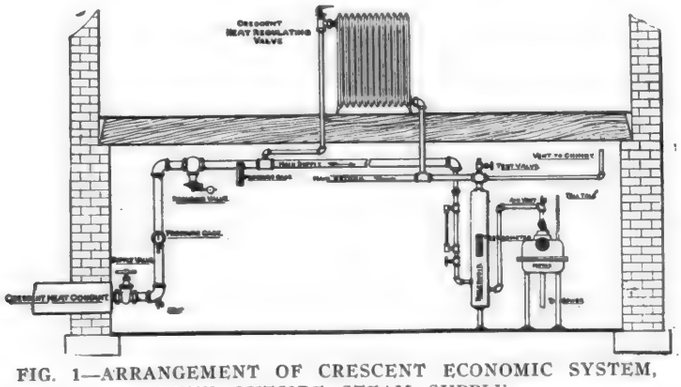


FIG. 1—ARRANGEMENT OF CRESCENT ECONOMIC SYSTEM, WITH OUTSIDE STEAM SUPPLY.

The manufacturers recommend the use of about 15% more radiating surface than is usually figured for steam and also the use of water radiators having a ¾-in. opening at one end (at top), and a ½-in. opening at the other discharge end (at bottom).

With an outside steam supply the pressure is reduced upon entering the building to about 8 oz. The end of the supply pipe is discharged to the lower part of a reservoir, as shown in Fig 1, while the return main enters the top from which the pipe for the discharge continues into the chimney flue, usually about 15 ft. above the entrance where the draft assists circulation. The discharge of condensation from the reservoir regulates the height of water, while the water gauge indicates the difference in pressure between the supply and return. Only one valve is used on each radiator.

The Crescent Economic valve, which controls the supply of steam to the radiator, is shown in Fig. 3. This valve is graduated to full opening and each valve is marked for the size of radiator intended. The manufacturers state that one size (¾-in.) is sufficient for all ordinary purposes.

In the matter of pipe sizes some useful rules are offered, the following being a general rule for ordinary installations:

Run. Feet	Supply, In. Diam.	Return, In. Diam.	Radiation Sq. Ft.
30	¾	½	50
60	1	¾	75
70	1¼	1	120
100	1½	1	160
150	2	1¼	280
200	2½	1¼	600
250	3	1½	900
250	3½	2	1500
300	4	2	2200
300	4½	2	2800
350	5	2	3600

As a matter of interest, an illustration is presented in Fig. 4 of the Crescent vacuum valve, which was erroneously given the title in last month's issue of the Illinois Thermo trap. This valve is designed for use in systems employing a vacuum pump. One is placed at the return end of each radiator. The valve consists of a closed copper float operating in a chamber from which the condensation is discharged to the return pipe. The air released at the top where the dirt is least effective. The amount of air can be regulated by a screw to suit each radiator and insure proper circulation without leakage. The air passage is sealed by the condensation in the chamber and the proper amount of air is discharged when the float lifts. As will be noted, the valve has no stem passing through the float which might

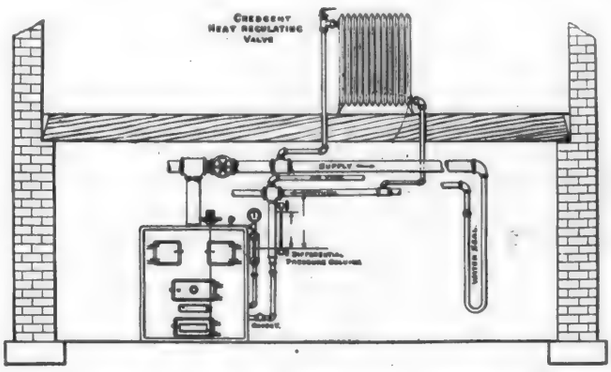


FIG. 2—ARRANGEMENT OF CRESCENT ECONOMIC SYSTEM, WITH INDIVIDUAL BOILER PLANT.

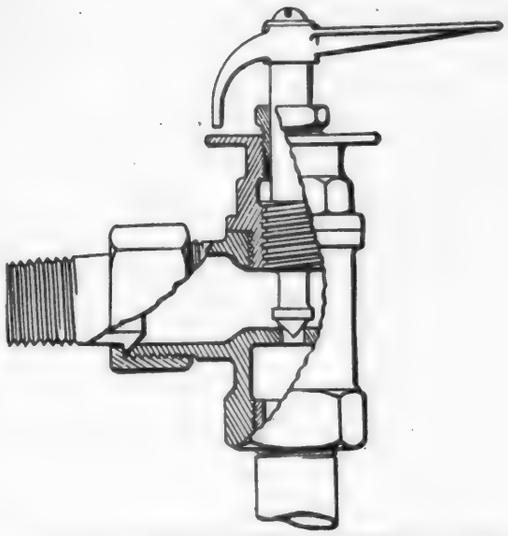


FIG. 3—CRESCENT ECONOMIC SUPPLY VALVE.

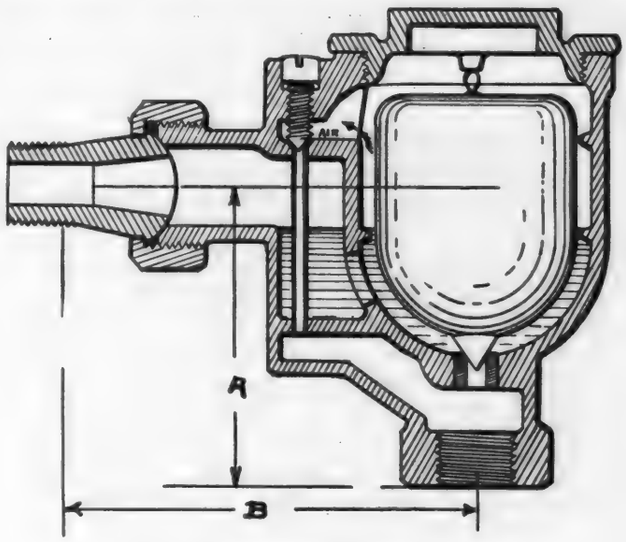


FIG. 4—CRESCENT VACUUM VALVE.

become clogged with dirt and no thermostatic feature. It is described as noiseless in operation.

The Crescent vacuum valve is made in two sizes and is adaptable for the following services:

½-in. for radiation containing 80 sq. ft. or less.
½-in. for radiation containing 125 sq. ft. or less.
½-in. for pipe coils containing 100 sq. ft. or less.
¾-in. for radiation containing 300 sq. ft. or less.
¾-in. for pipe coils containing 200 sq. ft. or less.

The valve has the following dimensions:

Size, In. Diam.	A	B
½	2¾ in.	3⅞ in.
¾	3¾ in.	5 in.

CORRESPONDENCE

Proper Connections for Vento Heaters to Eliminate Air Binding.

EDITOR HEATING AND VENTILATING MAGAZINE:

Can you tell me why the coils shown in the accompanying sketch do not vent properly?

A Vento stack of the size given and a vacuum return system, as indicated, with steam and return at opposite ends,

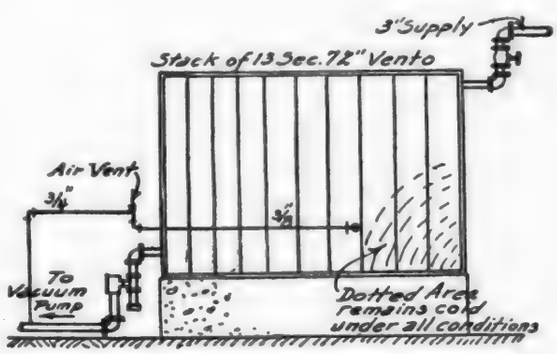


FIG. 1—VENTO HEATER CONNECTIONS AS MADE BY CORRESPONDENT.

is sufficient for proper results without the use of an extra air vent, provided the steam supply mains and branches are of proper size. The sketch (Fig. 1) shown by correspondent is incomplete as it does not indicate the condensation rate, position of stack in general heater and details of main supply piping.

The difficulty with the installation in question is probably due to inadequate main supply pipe system. The sketch in Fig. 2 shows the regular way of connecting Vento (up to 16 sections) where a vacuum return system is used.

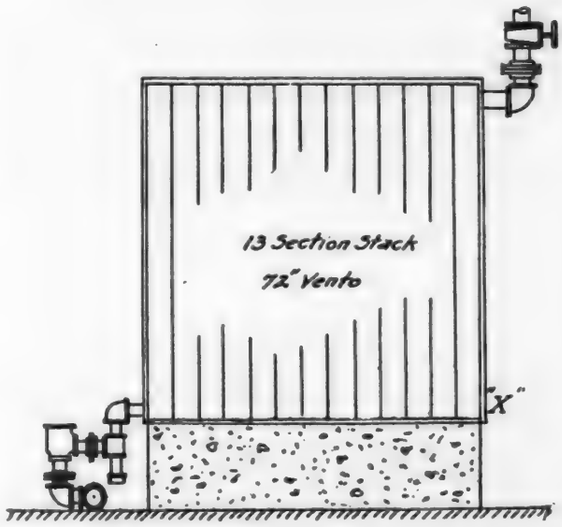


FIG. 2—PROPER VENTO HEATER CONNECTIONS FOR USE IN A VACUUM RETURN SYSTEM UP TO SIXTEEN SECTIONS OF VENTO.

This arrangement always gives good steam circulation when pipe sizes are correctly proportioned.

Accepting the condition as stated by the correspondent, the proper position for the small air vent connection is from the return outlet to the steam end of the stack designated "X" in Fig. 2 and connected into the return line leading to the vacuum pump. The air vent shown in Fig. 1 is too high up to be of any special value and also in the case in question, too far from the point of difficulty.

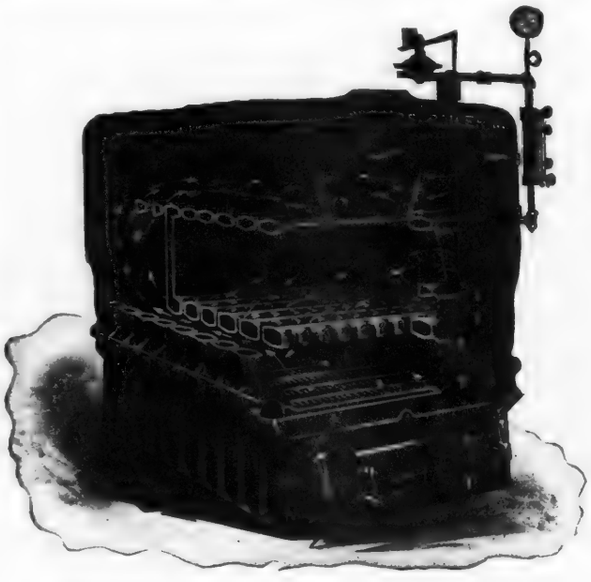
PRESENT STATE OF THE ART IN SMOKELESS BOILER CONSTRUCTION

The New Designs, together with the Latest Developments of Well-known Types that have proved Successful

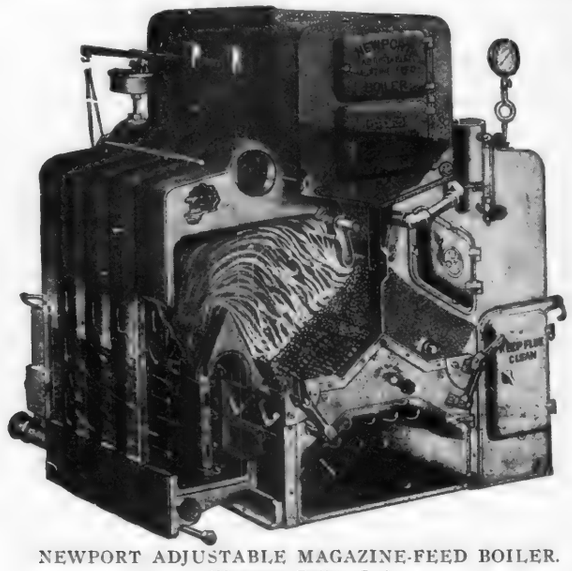
It is a remarkable tribute to the efforts of the manufacturers of smokeless boilers in securing recognition for their product that it is no longer necessary to educate the engineering public on the point that smoke is wasted fuel, whether it be in a power plant or in a house-heating system. This feature of the campaign of education so long carried on by smokeless boiler manufacturers may be considered as having been successfully accomplished.

Smokeless boilers, both of the down-draft and coking type, have gained a commanding position among accepted designs of heating apparatus and it only remains for the manufacturer to perfect the details of design and for the heating engineer to thoroughly familiarize himself with the various types on the market and to go more deeply into the matter of burning fuels other than anthracite or, at any rate, other than the larger sizes of anthracite.

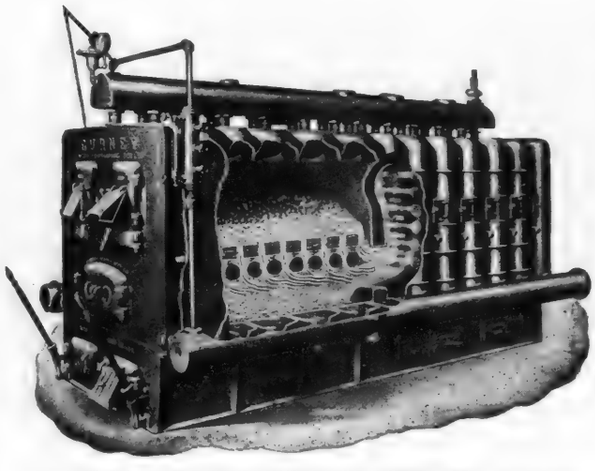
For the benefit of our readers we are presenting herewith sectional views of some of the principal smokeless boilers now on the market. Many of these heaters have been shown at one time or another in these pages, but are here grouped to permit of an easy comparison of their construction features.



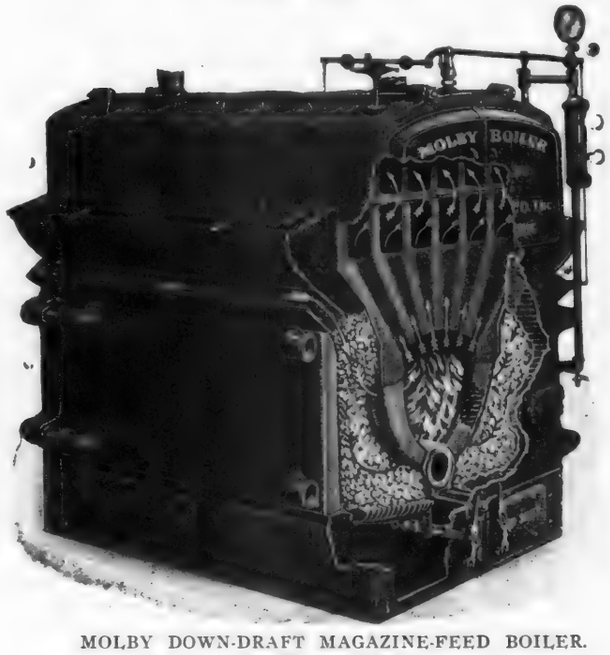
MONARCH DOWN-DRAFT SMOKELESS BOILER.
(The Wm. H. Page Boiler Co.)



NEWPORT ADJUSTABLE MAGAZINE-FEED BOILER.
(Newport Boiler Co.)



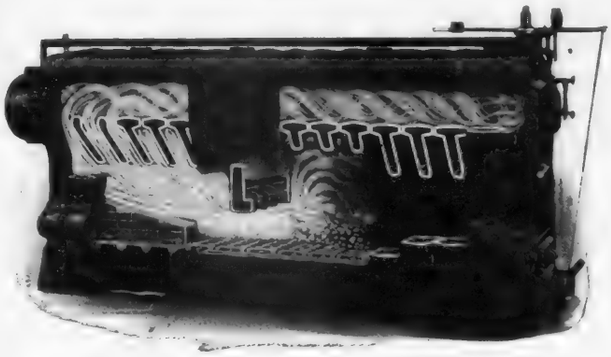
GURNEY DOWN-DRAFT SMOKE-CONSUMING BOILER.
(Gurney Heater Mfg. Co.)



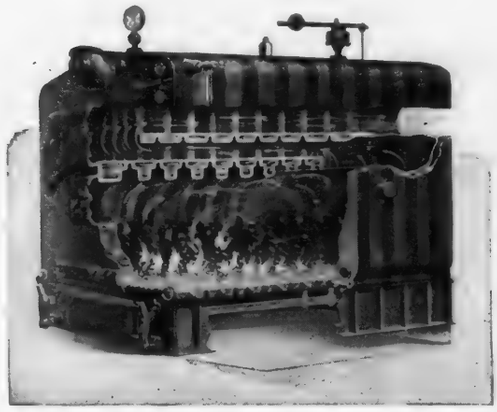
MOLBY DOWN-DRAFT MAGAZINE-FEED BOILER.
(Molby Boiler Co.)

IMICO DOWN-DRAFT SMOKELESS BOILER.
(Illinois Malleable Iron Co.)

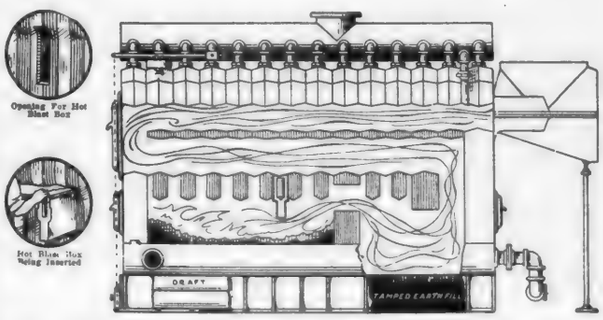
INTERNATIONAL ECONOMY SMOKELESS BOILER.
(International Heater Co.)



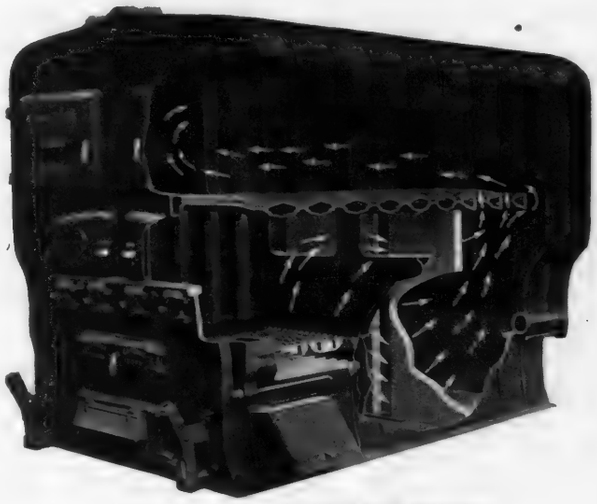
IMPERIAL SUPER-SMOKELESS BOILER.
(Utica Heater Co.)



IDEAL SMOKELESS UP-DRAFT BOILER.
(American Radiator Co.)



PROX DUPLEX ECONOMIC HEAVY DUTY AND EXTRA HEAVY DUTY, SINGLE GRATE, UP-DRAFT SMOKELESS BOILER.
(Frank Prox Co.)



CAPITOL SMOKELESS BOILER.
(United States Radiator Corporation.)

FUEL SAVING DEVICES

The Direct-Fired Method for Heating Large Spaces.

The economy of fuel consumption in the heating of industrial plants, it is claimed, has been advanced by a direct-fired method by which a large space can be satisfactorily warmed without requiring any distributing ducts and at the same time making use of only a single unit. Very little floor space is required and the heater can be located at any convenient point. A direct-fired heater has been put on the market by Skinner Bros. Mfg. Co., St. Louis, Mo., which for many years has been manufacturing the Baetz patent air heater.

Steam, in connection with a blower, is used as the heating medium in the Baetz heater. While this direct-fired heater likewise has a blower, the heat, as the name indicates, is generated from coke, coal, or other fuel fired directly into the heater. The manufacturers call attention to special and exclusive features which this heater possesses giving it an elasticity that permits an operation in harmony with weather conditions, thereby insuring a saving in the consumption of fuel as compared with stoves and salamanders.

DIRECT-FIRED HEATER FOR WARMING LARGE SPACES.

Accurate control of the fire may be maintained by means of a forced draft damper with which the intensity of the fire can be quickly increased or deceased as may be required. The blower or fan draws in the air at the bottom and forces it over the heated surface, the discharge being at the top.

It is stated that a very even temperature can be maintained in a large room with a single unit, while in unusually large plants a number of units may be installed. The fan, which requires comparatively little power, can be operated from a line shaft or by an independent motor.

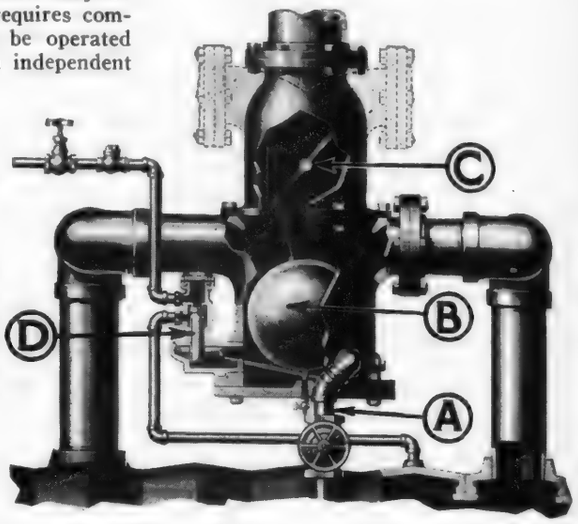
Saving Fuel by Maintaining a Constant Boiler Water Level.

Claims for both fuel and safety conservation are made for the Kelly high and low-pressure controllers on the ground that by their use boilers may be forced to their extreme limit without endangering them, thereby giving greater horse-power and efficiency, at the same time maintaining a constant water level with only ½-in. variation. The manufacturers of these devices state that through the use of their thermo-return controller, low-pressure boilers can be operated at from 10 to 25 lbs. pressure and still have a dry return line. This device puts the water back into the boiler under its own power. Another point mentioned is that the Kelly controller removes the hazard of cracked sections or explosions in either low or high-pressure boilers.

The construction and operation of this device for low-pressure work are shown in the accompanying illustration. The pipe connections are full size of the boiler tappings or outlets. In ordinary operation the steam entering the controller is forced downward by deflectors into the large chamber, reducing the velocity and separating the water from the steam. The water separated then passes into the bottom of the boiler through the bleeder pipe (A), leaving only dry steam to pass into the system above.

The communication valve (C) is set slightly off center and when in open position also acts as a deflector. When only a slight surging occurs, the water falls into the controller chamber where it is carried off to the boiler through the bleeder pipe.

When excessive priming occurs, the accumulation of water in the controller becomes greater than the bleeder pipe can carry away. As a result the float (B) rises, partially closing the communication valve (C). At the same time the lever below the float opens the auxiliary water supply valve (D) which discharges a small quantity of water into the boiler, reducing the temperature of the overheated water and thereby stopping the surging. During this operation the communication valve is not closed far enough to materially reduce the supply of steam to the heating system.



KELLY BOILER CONTROLLER, SHOWING METHOD OF OPERATION.

When the boiler becomes particularly unruly so that temperature reduction is not sufficient to safeguard it against the effects of siphoning, the float rises higher, entirely closing the communication valve and cutting off connection with the system above.

By confining the water to the boiler at all times and under all conditions, the controller serves to eliminate the explosion hazard and the cracking of sections.

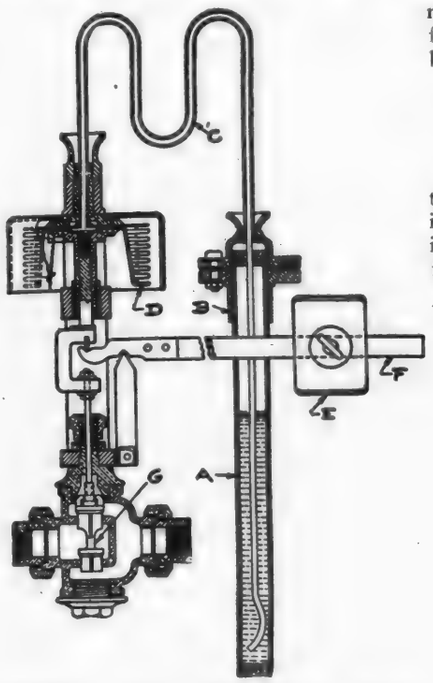
The removal of grease is accomplished by closing the gate valve on the bleeder pipe and turning on the water valve. The grease then flows into the controller chamber where it is withdrawn by opening the plug or drain cock in the bottom of the chamber.

An attachment is furnished, if desired, which serves as an automatic water feed.

The Kelly controllers for both low and high-pressure boilers are manufactured by the Kelly Controller Co., Chicago, Ill.

Savings Effected by the Automatic Control of the Temperature of Liquids.

An interesting example of the savings possible through the use of tank regulators for automatically and accurately regulating the temperature of liquids is given by the Fulton Co., Knoxville, Tenn., through the use of its Sylphon tank regulators. The problem cited is in connection with a dye vat. In this case the liquor was required to be heated to a temperature of 190° F. The surrounding water occupied a space of 100 cu. ft. As the



SYLPHON TANK REGULATOR, LEVER AND WEIGHT TYPE.

weight of 1 cu. ft. of water at 190°= 60.13 lbs., the amount of water required to heat the liquor to 190° = 100 × 60.13 =6000 lbs.

As it requires 1 B. T. U. to raise 1 lb. of water 1° F., and as there are 6000 lbs. to heat, it follows that it will take 6000 B. T. U. to raise the temperature of the liquor mass 1° F. As it is desired to maintain the temperature of the liquor at 190°, and as it is possible and very probable that hand control will allow such fluctuations that the liquor temperature will reach the boiling point, or 212° about once each hour, it follows that there will be an unnecessary rise of 22° which, multiplied by 6000 B. T. U. (the B. T. U. wasted in raising the liquor mass 1°) gives a total waste of 132,000 B. T. U. per hour.

In using bituminous coal it has been found that it is not possible to transmit more than approximately 5000 B. T. U. per pound of coal to the water, the remaining B. T. U. contents of the coal being absorbed by the draft, the drying out of moisture in the coal, and the ash content. Thus, dividing 132,000 by 5000, we find that 26 2/5 lbs. of coal are wasted. Figuring the price of coal at $6.00 per ton at the plant, we have a cost of ¼ cent per pound and this cost applied to the waste of 25 2/5 lbs. per hour gives a loss of 6 3/5 cents per hour, or 51 cents per eight-hour day, or $153.00 per year of 300 eight-hour days.

The foregoing does not take into account the saving in man-power effected by automatic control, or in overcoming the loss incident to overheating the liquor, nor does it take into account the radiation loss of the vessel in which the liquor is heated, or the loss of liquor due to its vaporizing at boiling temperatures. Added to all of the foregoing is the consideration that one man can handle processing in probably four times as many vessels as he could by hand regulation.

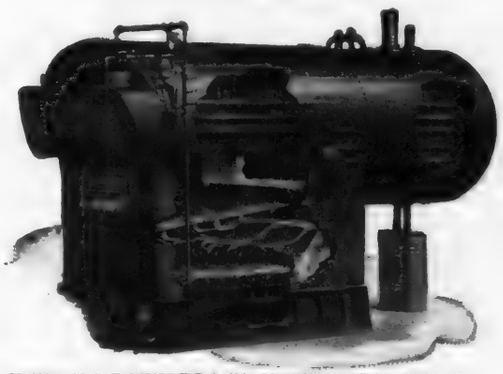
The Ja-Nar' as a Fuel Saver.

Savings in the coal bill made possible through the use of the Ja-Nar', which is an automatic device for maintaining uniform room temperatures, are furnished by the manufacturers, the Fulton Co., Knoxville, Tenn. In appearance the Ja-Nar' looks like a handsome cabinet made of heat-insulated metal which is placed over the radiator. It is opened at the bottom and has openings or louvres in the front. These louvres are operated by levers controlled by the Sylphon thermostat.

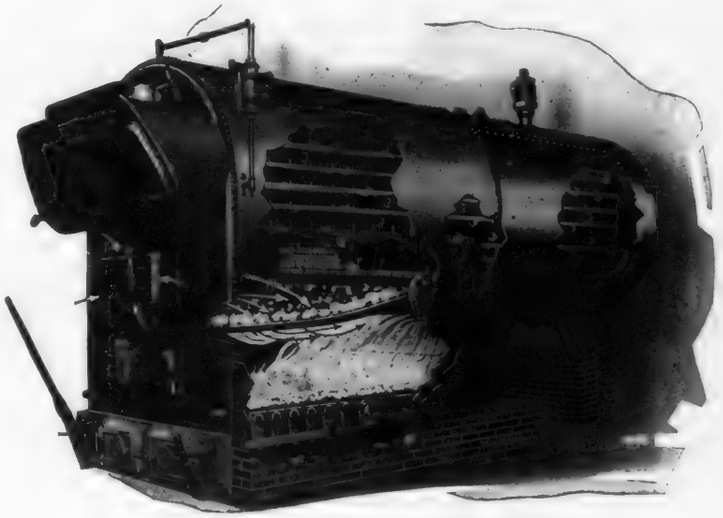
It will be seen that the amount of heated air sent out into the room is governed by the opening or closing of the louvres in the upper part of the Ja-Nar'. The Sylphon controlling device is in a separate compartment of its own, entirely insulated from the radiator. Through the grill in the end and in the top of the compartment the air of the room circulates and records its temperature on the Sylphon thermostat which, by expanding or contracting, operates the levers controlling the louvres. In this way, it is stated, the room may always be maintained at a uniform temperature and of course at the desired degree. All excess heat is returned to the heating system to be used, if necessary, in other parts of the house.

SMOKELESS BOILERS

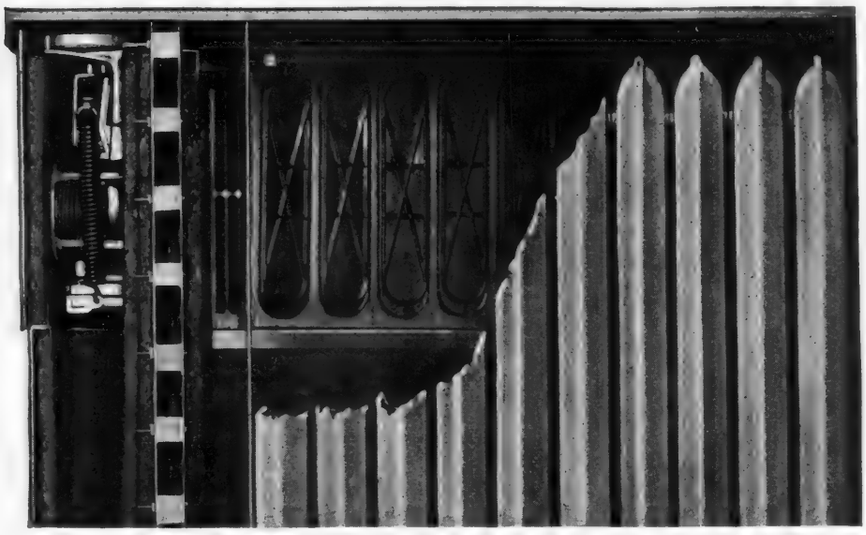
(Continued from page 61)



KEWANEE DOWN-DRAFT SMOKELESS BOILER.
(Kewanee Boiler Co.)



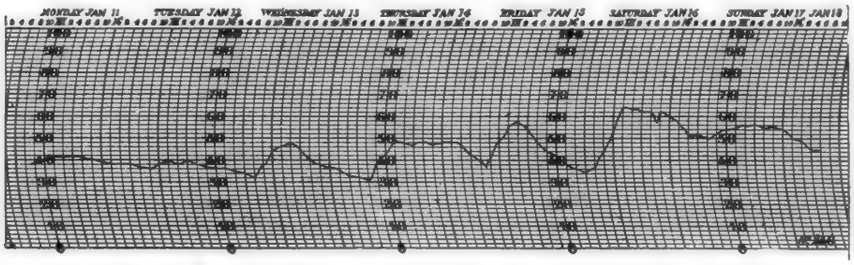
OIL CITY SMOKELESS BOILER
(Oil City Boiler Works.)



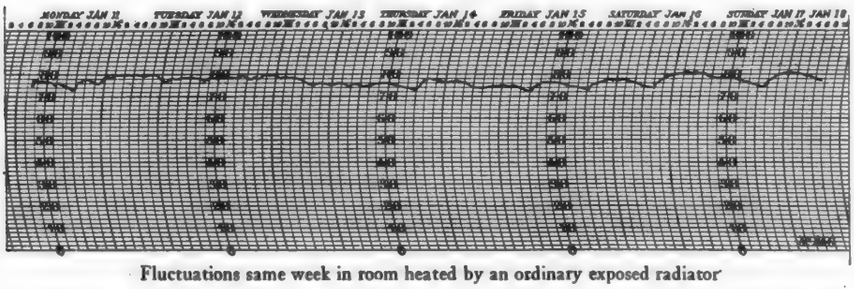
JA-NAR' RADIATOR CABINET FROM REAR, SHOWING LOUVRES, LEVERS WHICH OPERATE THEM, AND SYLPHON THERMOSTAT IN ITS SEPARATE CHAMBER.

The accompanying charts give the results of three tests made in Knoxville during January of a recent winter. The dates were January 11 to 17. The upper chart shows that the outdoor temperature varied greatly during this period. On January 16 the variation outside was from 34° to 64°. The center chart shows that this outside variation caused a corresponding variation in a room that was not equipped with the Ja-Nar', the variation running from 73° to 81°. The lower chart shows the steadying effect of the Ja-Nar' on the adjoining room. Here the temperature was practically constant, although the outside temperature varied 29° and high winds prevailed throughout the day.

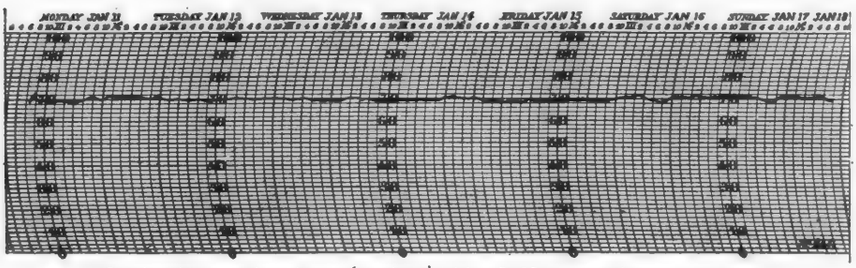
The manufacturers make the claim that where all or nearly all the radiators are covered by the Ja-Nar', 15% to 25% of the winter's coal bill can be saved. It should be noted, however, that the Ja-Nar' cannot be used on radiators of wall, ventilating or cast-iron base type, nor on those having top inlet or outlet.



Temperature fluctuations outdoors for a period of one week



Fluctuations same week in room heated by an ordinary exposed radiator



Comfortable, even heat in room equipped with a Ja-Nar'—same house, same week

RESULTS OF THREE TESTS OF INDOOR TEMPERATURES, THE THIRD WITH THE JA-NAR' IN USE.

Development of Farnsworth Closed-Loop Boiler-Feeding System for Process Work.

BY GEORGE S. BARKER.

Based on the principle of a closed-loop circuit for a heating system, which has been developed by the Farnsworth Co., Conshohocken, Pa., and which was described in last month's issue, this company has now designed a system which will be of special interest to manufacturers using steam for heating, drying and cooking purposes. It is intended to save coal and eliminate all water and air from the heating apparatus, at the same time providing a continuous flow of condensation direct from the heating apparatus into the boiler at all times.

The scheme may be readily understood by referring to Fig. 1 which shows a steam-jacketed kettle, dry-room coils, radiators and a closed water heater—all carrying low-pressure steam, controlled by a reducing valve, and a bank of high-pressure coils carrying steam at boiler pressure.

With the usual arrangement for handling condensation each of the above-mentioned apparatus would be equipped with a small trap, and each trap would discharge into a common return line leading to the hot well or open feed-water heater. That is, if the pressure carried on each apparatus was sufficient to discharge the small traps against a static head between the traps and the hot well or open feed-water heater. If such was not the case, a receiver would usually be placed at some low point in the building into which the traps could discharge, and then, by the use of a piston pump, the condensation would be taken from the receiver and pumped back into the hot well or feed-water heater, as the case might be. In most cases the receiver would be placed on a level with or slightly below the piston pump, and, therefore, a large amount of cold water would have to be run into the receiver in order to lower the temperature of the condensate to such a point as to prevent the condensate from flashing into steam during the suction stroke of the piston pump. The exhaust steam from the pump would go to the atmosphere. Altogether this condition would be found wasteful and would not clear the heating systems of air. The water seal in each small trap would be likely to prevent the escape of air from the heating systems.

If the conditions were such as not to require the receiver pump, the individual traps would discharge their condensate directly into a hot well, or, in other words, the condensate, which was at a high temperature and under pressure, would be liberated to the atmosphere, and a large portion of the condensate

would therefore flash into steam and the sensible heat in the condensate would be lost.

With the new design all low-pressure condensation, as shown in the sketch, is drained into a low-pressure condensation pump having a small spray in the top of the tank. The spray water is automatically controlled, so that when the tank is in the receiving position the spray water enters the tank and condenses the steam which was used for pumping. This pulls the condensation out of the various heating systems and serves to keep them free from water. As soon as the receiving chamber of the low-pressure condensation pump is full the tank rocks on a babbited bearing; the movement of the tank shuts off the water and opens the live steam valve which allows live steam to act upon the surface of the water in the tank. This forces the water out of the tank and up into the receiving chamber of the Duplex boiler feeder, located at least 3 ft. about the water-line of the boilers.

The operation of the Duplex boiler feeder was described last month and it will be only necessary to say that when the chamber of the low-pressure con densation pump is receiving, the tank is equalized with the system that is being drained, and when the chamber is discharging, the tank is under high pressure. The steam that is used for pumping, therefore, comes in direct contact with the water and helps to preheat it. The Duplex boiler feeder and the low-pressure condensation pump exhaust back into the heating systems, and therefore, the entire system is completely closed, preventing the loss of any heat.

The high-pressure condensation is drained into a condensation separator. This machine is similar to the low-pressure condensation pump, only that it does not have any live steam connection. As soon as the receiving chamber of this machine is full the tank rocks and the pressure on the system forces the condensation to the receiving chamber of the Duplex boiler feeder. The tank remains in the dumping position until all condensation has been completely blown out of the coils, then the tank, which becomes lighter than the counter-weight, rises and shuts off the steam, so that no steam can blow through.

Watt, the first real steam man, used a method similar to this to feed his first boiler. He, however, controlled the feeding by hand, while in this case the machine works automatically and alternately the chambers fill and dump.

The system here described is known as the Farnsworth closed-loop boiler-feeding system, and its application, it is stated, is of such a broad nature that there is scarcely a steam plant anywhere that can not use it to advantage and save coal, which is certainly of vital importance to the whole nation at this time.

New Publications.

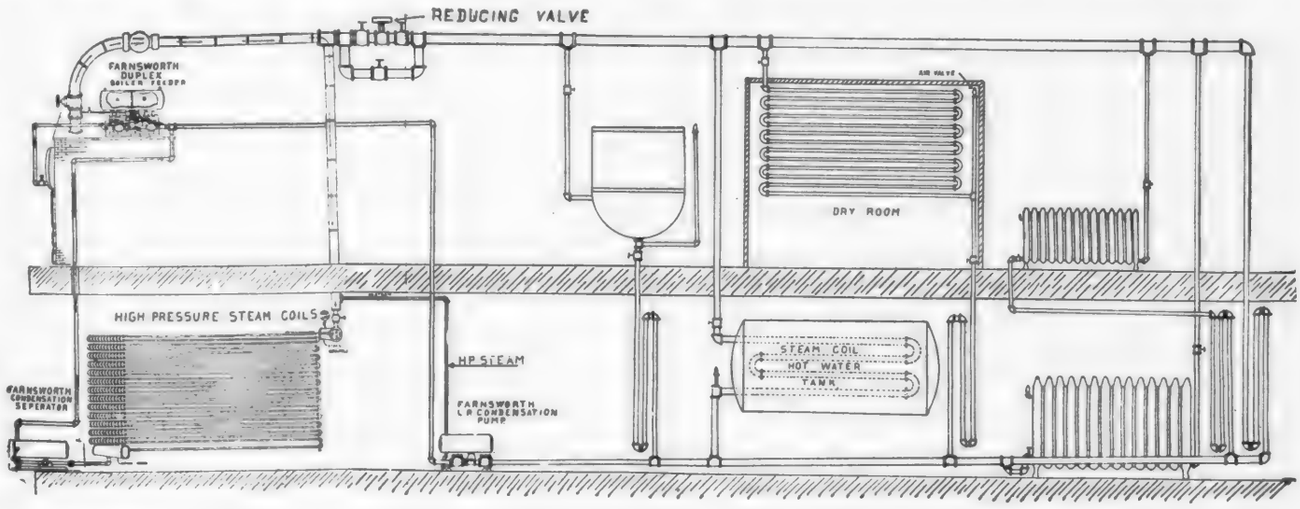
TIN, SHEET-IRON AND COPPER-PLATE WORKER, by Leroy J. Blinn, has been published, in a new and enlarged edition, by Henry Carey Baird & Co., Inc., New York. The book is described as a practical workshop companion. Size 5 x 7¾ in. Pp. 334, with 207 ills. Price $3.00. Orders may be addressed to the book department of THE HEATING AND VENTILATING MAGAZINE.

VALVE WORLD for July, published by Crane Co., Chicago, is devoted largely to the company's sixty-fifth anniversary. "Crane Company as it is To-Day," is the general heading of a series of articles giving a pen picture of the company's capacity and activities. Separate items deal with the company's numerous branches. While the extent of the company's operations has been known in a general way, this presentation brings them out in a most impressive manner. The facts and figures, it is pointed out, are not offered in a spirit of boasting, but with an earnest desire to place the company's capacity and effectiveness in the closest practicable touch with those desiring to buy and to use products and materials of unquestioned quality and workmanship.

FINAL REPORT OF THE FUEL CONTROLLER OF CANADA has been published and is a document that makes interesting reading. The first part of the report deals with the fuel situation in Canada during the war, while the second attempts to forecast fuel conditions of the future, with particular reference to means of promoting the conservation of coal, which, it is stated, doubtless will be a matter of supreme importance as time passes. The report comes out unequivocally for mammoth central heating and power plants as opposed to individual steam heating and power plants. Data are given to show that only in a few cases where a considerable amount of steam was needed for some manufacturing process or purpose besides power, were very large savings effected by isolated power plants, and the opinion is expressed that very good reasons should be shown before any isolated steam power plant should be permitted to be built or even continued in use in any part of Canada where water power is available.

On the subject of "Domestic Conservation," the report says: "The adaptation of our domestic heating apparatus to the utilization of soft coal would not only serve to carry the country through any period of anthracite fuel famine, but the greater use made of bituminous coal during Spring and Autumn weeks, and in the more temperate periods of winter, would mean a great reduction in our national coal bill. Experiments have recently been conducted which promise to give very satisfactory results in the matter of designing domestic furnaces for the utilization of our raw lignites available in the west. Similar investigations would no doubt yield satisfactory results with respect to burning bituminous coal in the east."

Central heating plants receive strong endorsement in the Fuel Controller's report. The endorsement is based on inquiries which were made by officers of the Fuel Control organization into the operation of central heating plants in various parts of the United States. It is estimated that 400,000 people in Canada have to spend some time daily through the winter months shoveling anthracite into the family furnace. It



FARNSWORTH CLOSED-LOOP BOILER FEEDING SYSTEM APPLIED TO PROCESS WORK.

is evident, continues the report, that in a central station well designed and properly operated there are great possibilities in the way of physical efficiency in the use of coal. Investigation to date would seem to indicate that the average efficiency of the Canadian house-heating equipment does not exceed 50%, while a modern central heating plant, in charge of an experienced stoker, should reach an efficiency of 70%. Against this, it is added, must be placed the inevitable loss involved in the transmission of the heat to its ultimate destination, technically called the "line loss." The extent of this loss is difficult to estimate, owing to the different conditions prevailing in connection with central heating projects. One important factor is necessarily the distance of the average consumer from the heating plant. Investigations by the United States Bureau of Mines indicate that the "line loss" is between 4% and 12% of the heat generated. Even with this deduction, declares the report, there is still a clear advantage in favor of the central system.

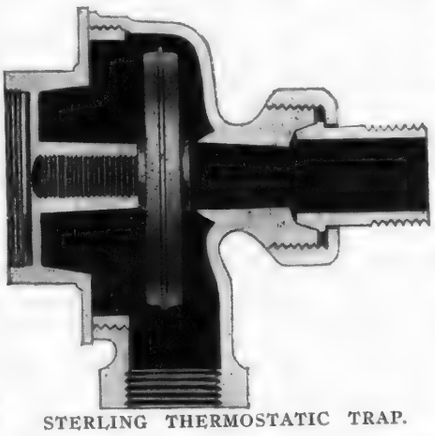
The report speaks of the point that any saving attained by this method would mean that much profit to the central organization and then mentions the other considerations that must be taken into account, particularly the possibility of using bituminous instead of anthracite coal in such plants. "It is a peculiar fact," comments the report, "bearing on this phase of the question, that the greatest development of the central heating system in the United States is precisely in districts where coal is cheapest, while one would have expected that the most promising field for central heating would be in the districts where coal was dearest and where the economy effected consequently would be largest."

Coming to the consideration of the relative cost of burning anthracite in the individual equipment and that of burning bituminous coal in the central heating plant, the report finds that the average cost of anthracite coal was $2.89 a ton higher than bituminous coal. Granting that the fuel value is practically equal, it will thus be seen, says the report, after giving the figures in detail, that a saving in cost of fuel amounting to practically 60% may be effected where conditions permit of introducing the central heating plan. Regarding the matter of coal handling the report states that throughout 1918, the average cost of handling anthracite in the provinces of Ontario and Quebec was approximately $2.25 per net ton, to which should be added the excess of cost of anthracite f. o. b. station over bituminous, say $2.75, making a total estimated saving in favor of bituminous coal of $5.00 per ton. From this would have to be subtracted the cost of handling bituminous coal in a central heating plant, say $1.00 per ton.

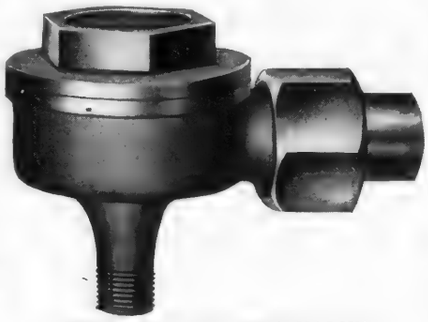
The report expresses the opinion that there would seem to be a particularly favorable field for central heating in the smaller communities in western Canada, and also in the eastern part of the country where power is generated in steam plants. Mention is made of the survey made by the Dominion Water Power Branch which showed that there is generated in Canada, in connection with central electric light and power plants operated by steam, a total of 192,110 H. P. Such being the case, says the report, it would appear that there should be a reasonably favorable field for utilizing exhaust steam for central heating purposes. Size 6 x 9. Pp. 108.

The Sterling Heating Specialties

Some confusion may have arisen in the minds of our readers due to the fact that an illustration of the Sterling thermostatic trap inadvertently appeared in the advertisement of the Ideal Heating Equipment Company, in a recent issue; while an illustration of the Sterling air line valve was published under the title of the "Illinois Vent Seal Valve" in the August number.



STERLING THERMOSTATIC TRAP.



STERLING AIR LINE VALVE.

The accompanying illustrations show the specialties in question which are manufactured by the Sterling Engineering Co., Milwaukee, Wis. The Sterling vapor heating system was described in THE HEATING AND VENTILATING MAGAZINE for April, 1920.

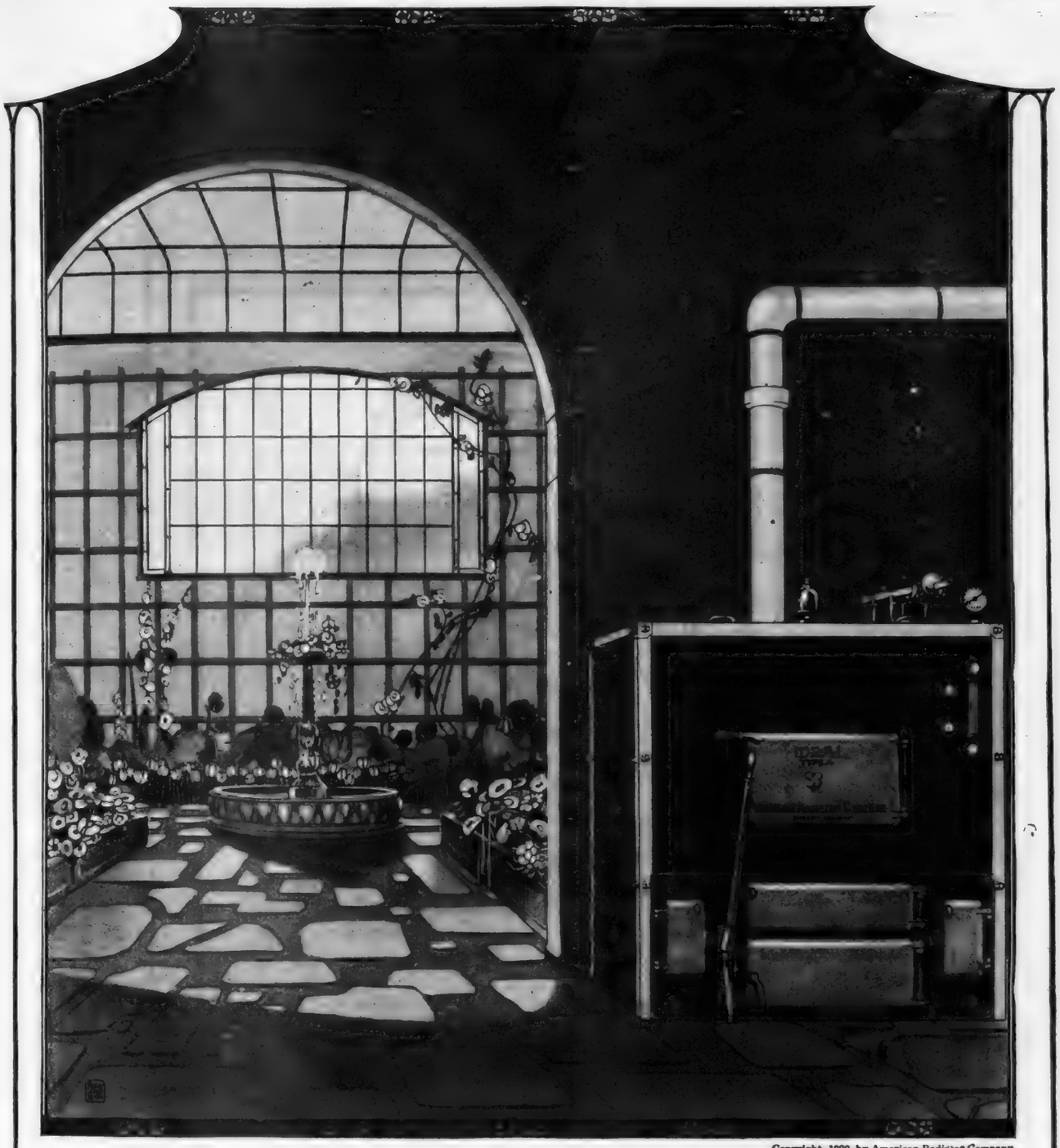
Deaths.

WILLIAM L. BRONAUGH, one of Chicago's well-known and popular heating engineers, died July 26 in Chicago from an acute attack of indigestion. He was 50 years old. Mr. Bronaugh had specialized, in recent years, in sheet metal work for heating and ventilating systems. He was a former secretary of the Illinois Chapter of the heating engineer's society and was a member of the Chicago Athletic Association and the Chicago Engineers' Club. Mr. Bronaugh had the happy faculty of making friends and the news of his death comes as a shock to all who knew him. He leaves a widow and one daughter.

FRANK C. JENNINGS, a member of the tin plate and metal firm of Bruce & Cook, New York, died at the home of his brother, Henry Jennings, in Bloomfield, N. J., August 6. He had just passed his 60th birthday. His death was the result of a stroke of apoplexy which he suffered last November. He was confined to the house from that time until his death. Mr. Jennings was one of three brothers who entered the firm at an early age and later became members of it. Under their management the firm became one of the largest importers of tin plate and pig tin up to the establishment of the American tin plate industry. In spite of his business activities Mr. Jennings found time to enjoy the lighter side of life. He was a charter member of the Eastern Trade Golf Association and was widely known as an expert golfer. He belonged to a number of clubs. Mrs. Jennings and a brother, Henry Jennings, survive him.

BERNARD GAUSE, head of the Gause Plumbing & Heating Co., Jacksonville, Ill., died July 19 at his home in Jacksonville. He was 50 years old. He had lived all his life in Jacksonville and became one of the city's prominent and successful business men. When a lad of 16 years Mr. Gause entered the employ of George E. Matthews, a veteran heating and plumbing contractor of that city. This was in 1887. Later he was taken into partnership by Mr. Matthews and finally purchased Mr. Matthew's interest in the business. He was for two terms elected president of the Illinois Master Plumbers' Association. He was also a member of the American Society of Heating and Ventilating Engineers. Although vitally interested in public affairs, Mr. Gause never held public office. He was almost a regular attendant at city council sessions and his advice was much sought after in community affairs. He had been in failing health several months previous to his death.

BEVERLY R. VALUE, president of the Associated General Contractors of America, died June 10 at St. Luke's Hospital, New York, following an operation. He was 63 years old. At the time of his death he was vice-president of the Kerbaugh-Empire Company, and secretary, treasurer and director of George W. Rogers & Company. In the last few years his companies were engaged in barge canal and canal terminal contracting, as well as in railroad construction in Baltimore. His place as president of the Associated General Contractors of America was filled by the election as president of Walter J. Drummond, of the Beaver Engineering Company, formerly second vice-president of the association.



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THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

WATER HEATING—GRAVITY.

Two-Pipe Circuit System.

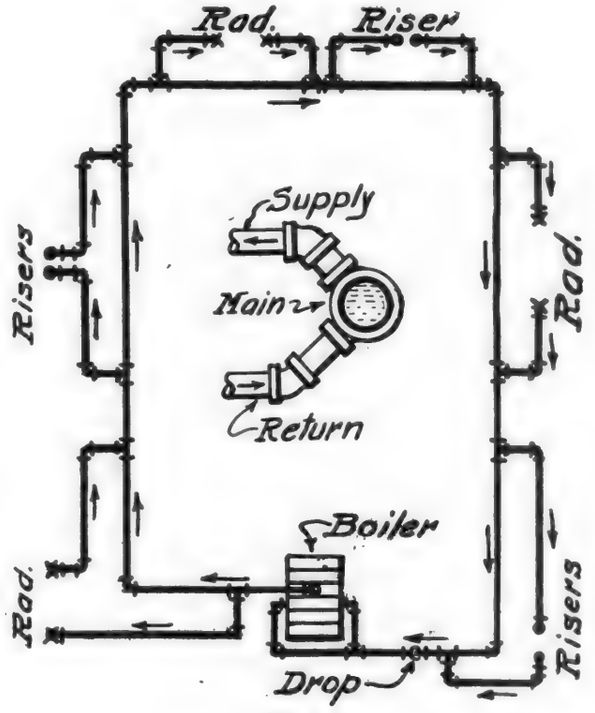

FIG. 1

Occasionally a water heating system is found employing a two-pipe up-feed riser system, with a single pipe circuit main at the bottom. The idea is somewhat similar to that employed in the one-pipe system described in Standard Data Sheet No. 133-C, but as the basement main is horizontal, the friction in the main is depended upon to assist the circulation into the supply riser. Fig. 1 illustrates a typical circuit main of this character, and it will be noted that the supply risers are always branched from the main at point as near the boiler inlet as possible. The return drop, however, is connected back into the same main at a point as far away from the supply connection as possible. The friction in the pipe existing between the branching of the supply and the connecting in of the return causes a slightly greater pressure to exist at the point of the supply branch than exists at the point of the return coming back into the main and the farther apart these connections are made the greater this difference in pressure will be and the greater will be the tendency to circulate the water through the radiators.

In the circuit main it is usually customary to size the main to carry the total load and to maintain this size undiminished throughout, although theoretically and practically it can be reduced between the supply and return connections, on account of some of the water being shunted through the radiators.

This main should be graded up from the boiler outlet to the last riser connection and then down to the boiler return inlet or may be carried to a high point directly over the boiler (this high point being vented by a supply branch being connected thereto) and then pitched down constantly and continuously from this high point to the return connection of the boiler.

With systems of small size a circuit main may give reasonable satisfaction, but where larger installations are contemplated some other scheme must be adopted if satisfactory operation is expected.

WATER HEATING, GRAVITY—Two-Pipe Circuit System. No. 133-L

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

WATER HEATING—GRAVITY.

Expansion Tanks.

All water heating systems should have an expansion tank, the only exceptions being where systems are fed from a house tank or street main and are under direct pressure at all times without a valve in feed-water line so that this line can act as an expansion pipe, the water expanding back into the tank or main as the case may be. Such conditions exist in installations where radiators are connected to the hot water service supplying hot water to the plumbing fixtures.

The expansion tank should be large enough to contain all the excess water due to expansion plus about 50%. For ordinary small systems many manufacturers rate their expansion tanks in square feet of radiation, a typical list being given in Data Sheet No. 133-B.

For large systems the quantity of expansion should be calculated. This can be approximated by allowing one pint of water as contained in each square foot of radiator surface, add 25% for the water in the piping (or calculate the exact quantity in the piping if the system is designed and all lines sized) and add one pint for each square foot of heating surface in the boiler or boilers.

Example: Compute size of expansion tank for 14,000 sq. ft. of surface with two boilers, each rated at 10,000 sq. ft.

Solution:

14,000 sq. ft. @ 1 pint = 14,000 pints = 1750 gal.
25% for piping = 1,750/4 gal. = 437.5 gal.
Two 10,000 ft. boilers =

$$\frac{20{,}000 \times 150}{33{,}000} = \frac{1000}{11} = 90 \text{ H. P.}$$

90 × 10 sq. ft. = 900 sq. ft. and
900 × 1 pt..... = 900/8 = 112.5 gal.

2300 gal.

Assuming system filled with water at 50° F. and that it may be heated to 220° gives a temperature rise of 220 — 50 = 170° for expansion of water. From tables giving the properties of water we find that, if the volume at 39.1° is taken as 1, at 50° the volume is increased to 1.00025 and at 212° to 1.04332, making the net increase in volume 1.04332 — 1.00025, or 0.04307 and 0.04307 ÷ 1.00025 = 4 3/10%, or say, 5%.

Then if the total volume is 2300 gal. the expansion in heating from 50° F. to 212° F. will be approximately 5% of 2300 or 115 gal. Adding 50% to obtain the expansion tank capacity gives

Expansion of Water..... 115 gal.
50% of 115..... 57 gal.
Total..... 172 gal.

This is at the rate of 172/14 or 12 gal. per 1000 sq. ft. of radiation.

WATER HEATING, GRAVITY—Expansion Tanks. No. 133-M

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

WATER HEATING—GRAVITY.
Details.

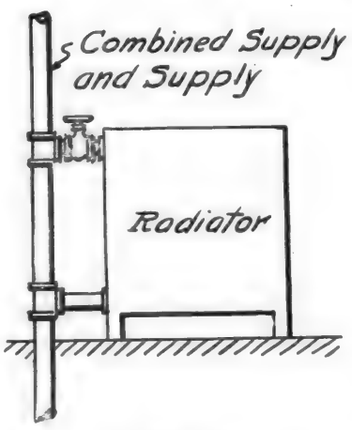

FIG. 1

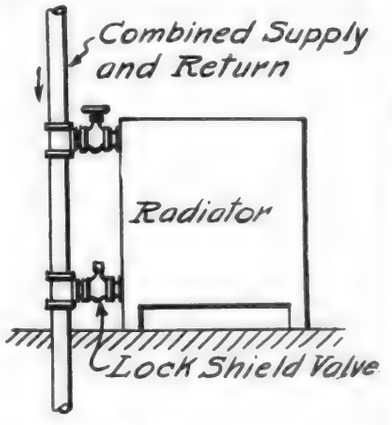

FIG. 2

In all one-pipe gravity water heating systems the radiator connections are practically the same; these connections are usually made top-and-bottom, same end as shown in Fig. 1; the valve should be a gate valve with a ⅛ in. hole drilled through the gate to prevent freezing.

In Fig. 2 the connections are shown with the addition of a control valve on the return to control the circulation through the radiator. The danger in such systems, however, consists of the liability of the radiator not getting enough water (due to the full size by-pass which the main drop provides) rather than a liability of the radiator getting too much.

Even with the mains and risers sized by the methods shown the tendency is for the hottest water to seek the top radiators making it necessary to use various expedients to control the flow and to induce a proper circulation in the lower radiators. Of course, all devices to control hot water circulation consist of introducing additional resistance in the lines at points where the circulation has become excessive and resulting in preventing other parts of the system having greater resistance (or less favored positions) getting a good circulation.

These methods of control may be divided into

(a) Special fittings
(b) Special pipe connections
(c) Special control valves.

FIG. 3

A special fitting designed for just such conditions is shown in Fig. 3, the idea of this fitting being to induce a flow into the radiator at the level where the fitting is located in preference to flowing up the riser to the higher points.

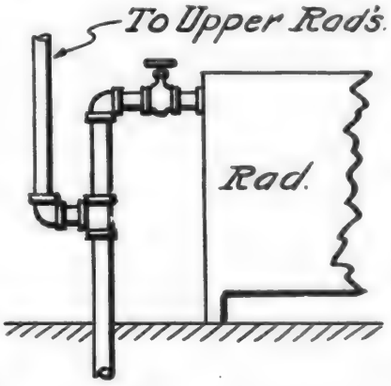

FIG. 4

Pipe connections to produce the same results even more positively are shown in Fig. 4 where the hot water in rising to the top of the pipe is left only one place to go (into the radiator) while the supply for other radiators above is taken from the side of the riser lower down as shown; these connections are repeated at each of the lower radiator connections, but need not be put in on the upper levels as these radiators do not need favoring.

WATER HEATING, GRAVITY—Details. No. 133-N

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

WATER HEATING—GRAVITY

Details (Cont'd).

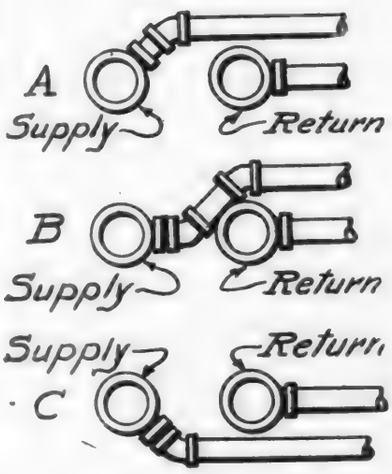

FIG. 5

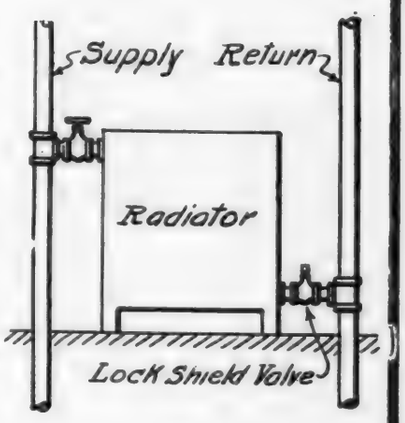

FIG. 6

Similar results are obtained in the horizontal mains where the risers are branched off as shown in A, B and C in Fig. 5, Detail C being used for about one-third of the risers nearest to the boiler (which would otherwise obtain the hottest water and the best circulation), Detail B being used for about one-third of the risers, these being located about midway between the boiler and the end of the main, and Detail A for the last third of the risers at the far end of the system.

Special control valves are by far the most satisfactory of all methods of controlling the circulation as they may be set in any graduated degree desired or left open entirely if the circulation is satisfactory. It is indeed a question (when the extra cost of special fittings or special pipe connections is considered) if the control valve is not very nearly as cheap as any other method of control—certainly its results are much superior. A gravity water heating system without control valves is much like a ventilating system without volume dampers.

If key-operated valves are placed on the return connection of each radiator, as shown in Fig. 6 and the rest of the piping is designed with proper pitch and so as to avoid air pockets no further precautions need be taken, for all that is necessary to do is to begin at the hottest radiators and gradually close the return valve until the resistance to the flow of water through them is sufficient to induce a circulation in the other radiators not receiving their full quota. After once adjusting the system in this manner the return valves can remain set permanently and the radiators controlled by the supply valves.

All radiator valves for hot water should have a ⅛-in. hole drilled in them so that the circulation in the radiator will never be entirely stopped even when the radiator is closed off. This will prevent damage by freezing under any ordinary conditions.

WATER HEATING, GRAVITY—Details (Cont'd). No. 133-O

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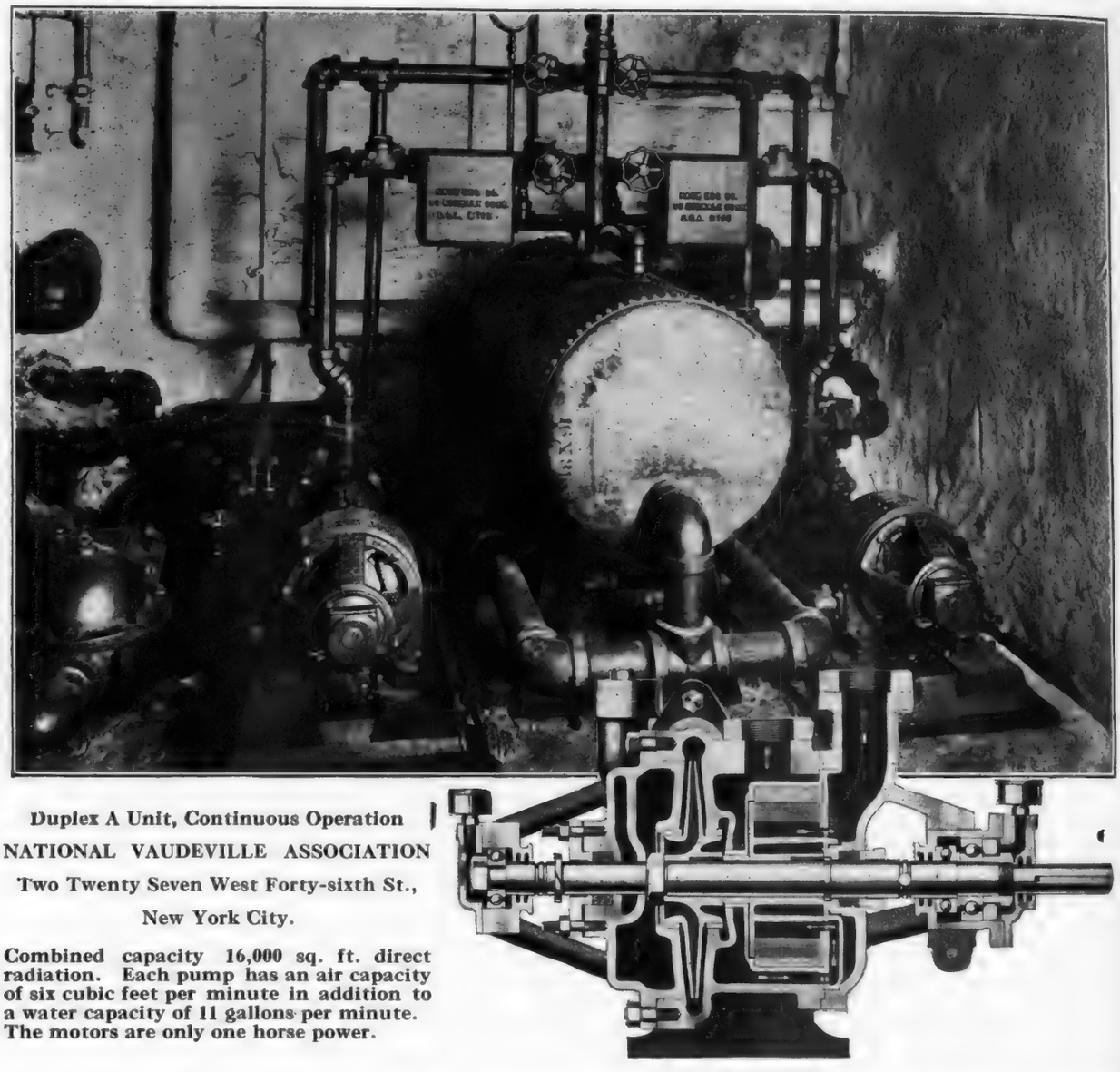

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Because of its compact design, this equipment can be installed in less than one-third the space necessary with other apparatus. All interior parts are bronze, supported on annular ball bearings mounted outside of casing. Moving parts revolve without contact.

There are many other reasons why the Jennings is being installed on practically all of the big jobs. Bulletin No. 8 gives them in detail. Write for it.

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TRADE AND MISCELLANEOUS NOTES

Miscellaneous Notes.

Engineering Institute of Canada announces that a general professional meeting of the institute, sponsored by the Ontario Provincial Division, will be held at Niagara Falls, Ont., September 16-18. The Welland Ship Canal and the Niagara power developments of the Hydro-Electric Power Commission, two of the largest pieces of construction work on the continent, will be visited. Headquarters will be at the Clifton Hotel.

Franklin Union Heating and Ventilating Society, an organization made up of graduates of Franklin Union, Boston, Mass., which during the past few years has successfully conducted a course of instruction in heating and ventilation, held a reunion, July 10 at Suntaug Lake Inn, Lynnefield, Mass. It was attended by 53 of the 90 members of the society. The success of the course was attested by the fact that many of the graduates have become successful salesmen, while a number of concerns in Boston are making it a practice to look to the Union for men as needed. The officers of the alumni's society are: President, Harry E. Connell, United States Radiator Corporation; Secretary, Harry G. Dodge, Gurney Heater Mfg. Co.

Elgin, Ill.—A fine of $5 00 minimum and $200.00 maximum, for violation of the ordinance pertaining to the installation of warm-air furnaces without securing a permit from the building inspector, has been established by the Elgin city council through the passage of an amendment to a previous ordinance. The original ordinance provided that warm-air furnaces must be so installed as to afford ample protection against fire by the use of asbestos and by allowing adequate air spaces in placing pipes and registers. The penalty portion had been omitted in the original draft.

July Building Operations, according to the F. W. Dodge Company's review of building activity, during the month of July, showed a decline of 21% from the previous month. Contracts awarded in territory east of the Missouri River and north of the Ohio Rivers amounted to $204,398,000. Building conditions, states the company, have been without a precedent in the past. In 1919, July was the month that showed the largest amount of work started, whereas this year the July figure is lower than that for any previous month. The fact is, continues the statement, that in previous months of this year contracts were awarded in such great volumes as to severely strain the country's capacity for production of the finished buildings, especially in view of the difficulties of transportation of materials. The present slump affords the construction industry a chance to catch up on existing contracts.

In the meantime, the report states, the demand for construction continues to pile up. Contemplated projects from January 1 to August 1 have amounted to $3,300,000,000, which is very nearly double the volume of work started, which has amounted to $1,746,000,000. The accumulated demand, it is added, must operate in favor of increased amounts of work started just as rapidly

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as the retarding conditions show signs of improvement.

Taking the country by sections, the New England district came close to the average monthly figure for the first half of the year. In New York State and northern New Jersey there was a marked decline to $36,430,000, less than half the June figure. In Philadelphia, Baltimore and Washington section, there was slightly more activity than in June. In Pittsburgh the figures ran $8,000,000 less than in June, totaling $36,006,000. The Central West with figures of $69,534,000, showed a decline of $15,000,000 from June, while in the Northwest, the July building contracts amounted to $9,391,000, an increase of $2,000,000 over the June figures.

New York.—Manhattan Bureau of Buildings reports that for the six months ending June 30, plans were filed for the construction of 434 new buildings to cost $67,382,458. This compares with 182 buildings, costing $24,034,463 during the same period a year ago. The plans filed covered ten dwellings, fifteen tenements, two hotels, 28 store and loft buildings, 48 office buildings, 16 factories and workshops, three schools, one church, one municipal building, eleven places of amusement; six hospitals, 269 stables and garages and 24 other structures.

New York's Housing Shortage is rapidly assuming such proportions that a crisis is now looked for early in the Fall. Before that time the special session of the State legislature, called to consider the housing session, will have begun. In the meantime investigations under way by the Senate Committee on Reconstruction and Production, the Lockwood Joint Legislative Housing Committee and the Mayor's Housing Conference Committee, have brought out volumes of testimony all pointing to the same conclusion that the shortage of homes in the city is acute. The Senate Committee, through the chairman, Senator William M. Calder, has

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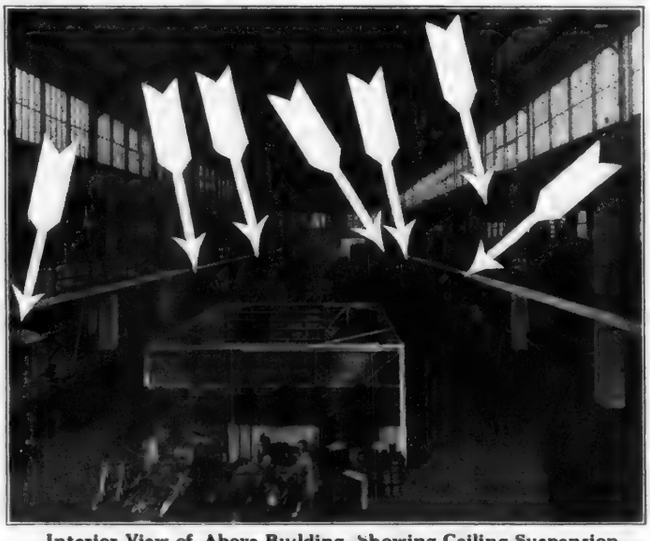
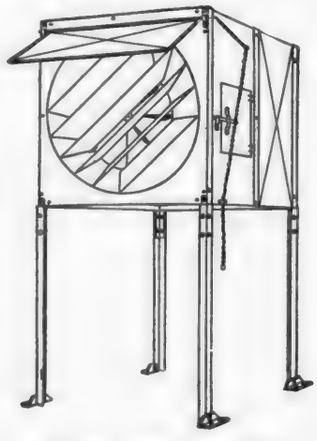


Interior View of Above Building, Showing Ceiling Suspension Type of Ilgair Unit Heaters



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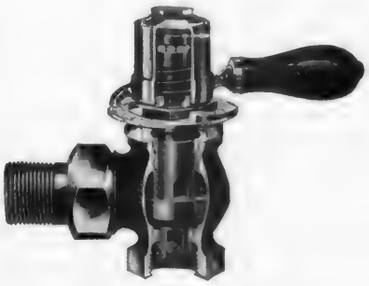

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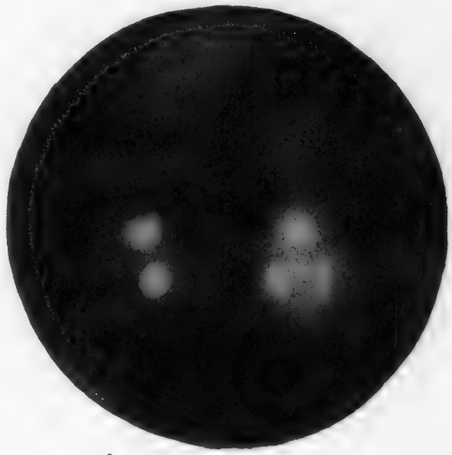

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H. W. JOHNS-MANVILLE CO., New York City
10 Factories—Branches in 63 Large Cities
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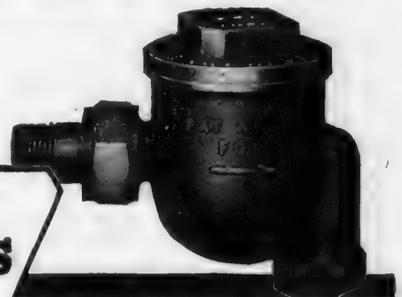

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Since 1864

reported to the Interstate Commerce Commission that relief from the present housing conditions must come about through construction work started during July, August and September and that, if the freight embargoes against building materials persisted, relief for the congested districts would not be achieved during the present year. The committee was informed that a hearing would be given as soon as the subject could be reached by the commission.

Frank Mann, commissioner of tenements for New York City, placed the present dearth of apartments at 100,000 in that city alone and estimated that by 1921, the shortage would reach 120,000. Walter Stabler, comptroller of the Metropolitan Life Insurance Company, which lends immense amounts of money for building purposes, told how rents had shot up from 75% to 300% and how the mortgage market is demoralized since mortgage incomes are taxed and there are other investments that are tax exempt.

Figures have been submitted to the Lockwood Committee by Lawson Purdy, former head of the New York City Department of Taxes and Assessments, showing that to adequately house the ever-growing population of New York there should be spent within the next ten years the sum of $1,500,000,000 for new buildings.

In connection with the agitation for a government subsidy to encourage building operations the Mayor's Housing Conference Committee, in its report, takes the position that a direct government subsidy is not feasible, nor does it believe that any plan for municipal or State building construction is either practicable or desirable. "Any plan," states the report, "that will enable the city or State to build houses must of necessity be delayed too long to be of any practical value, even if it were not objectionable from an economic and governmental point of view." The committee believes that the proper solution will be obtained by the enactment of legislation to exempt immediately all income derived from real estate mortgages from income taxes of the State and federal governments, and to exempt new houses from local taxes for a limited time. The committee also urges legislation authorizing some responsible public body to pass on permits for construction, such as the creation of a housing commission vested with powers, for the time being, to pass on all permits for buildings.

Figures on the present rate of building in New York City, compiled by Secretary Edward P. Doyle of the Mayor's Housing Conference Committee, show that 12,662 dwellings were under construction in the greater city July 1. A step to relieve the situation has been taken by Borough President Henry H. Curran, who has asked the State legislature in its special session to take action to amend the city's charter to enable New York to spend $10,000,000 in the erection of buildings on municipally-owned real estate, and then rent them to tenants.

Combustion Engineering Co., New York, announces the appointment of Henry Kreisinger, until recently with the Bureau of Mines, as engineer of research for the company. It is stated that Mr. Kreisinger will conduct investigations along the lines of those carried on at the Bureau of Mines, for the benefit of the corporation's clients and also the government.

"Now Comes the 'Human Engineer'" is the heading of an article in a recent number of the *Dodge Idea* in which this designation is given to the specialist in medicine, engineering and industrial management. As this field is being occupied more and more by the heating engineer it looks as if this title were coming his way. The writer goes on to say that the duties of the "human engineer" will include a study of dust conditions in places where people work and will also embrace the matters of safety, sanitation and general welfare. The doctor, it is stated, however capable, who holds himself in readiness to only give first aid attention to persons injured or taken ill while at work, no longer meets the full need which virtually every manufacturing establishment presents in the medical or allied fields. To be thoroughly efficient, the factory doctor must be something of an engineer, as well as manager. The writer admits that there are not many, or any,

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   The Whitlock Feed Water Heater saves 13% of the coal burned under the boiler.
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   The boiler gains 13% capacity when used with a Whitlock Feed Water Heater.
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   Where a Whitlock Heater is used, there are no "local strains."

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"Whitlock Heaters Have Everlasting Copper Tubes"

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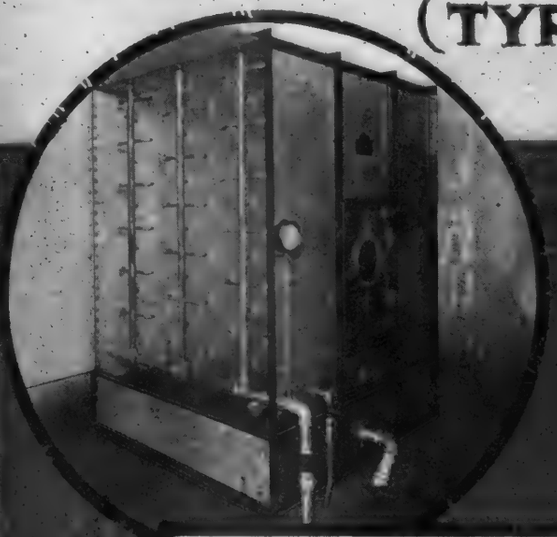
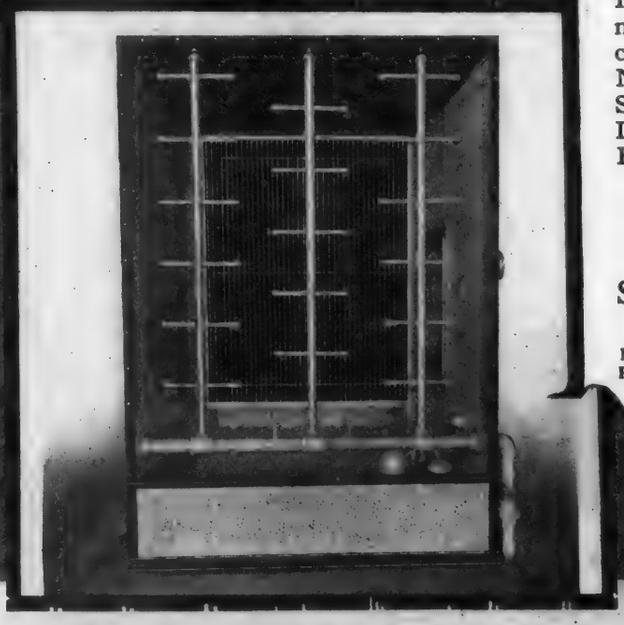




AN AIR WASHER IS OF VALUE ONLY WHEN IT IS RUNNING

You are not interested in shutting down every day or so and cleaning out the nozzles

The special construction of the
SPRACO
CENTER JET NOZZLE
makes it practically
NON-CLOGGING

In actual comparative test—made by the prospective customer—the SPRACO NOZZLE CONTINUED TO SPRAY LONG AFTER ALL ITS COMPETITORS HAD ENTIRELY CLOGGED.

Write for bulletin 8 on type C Air Washer.

Spray Engineering Company
Boston, Mass.

Mfgrs. of Spraco Air Washers & Cooling Ponds, Spraco Paint Guns & Cement Sprayers, Spraco Nozzles, Vaughan Flow Meters, etc.

THE·CENTER·JET·NOZZLE
Highest Efficiency by Test

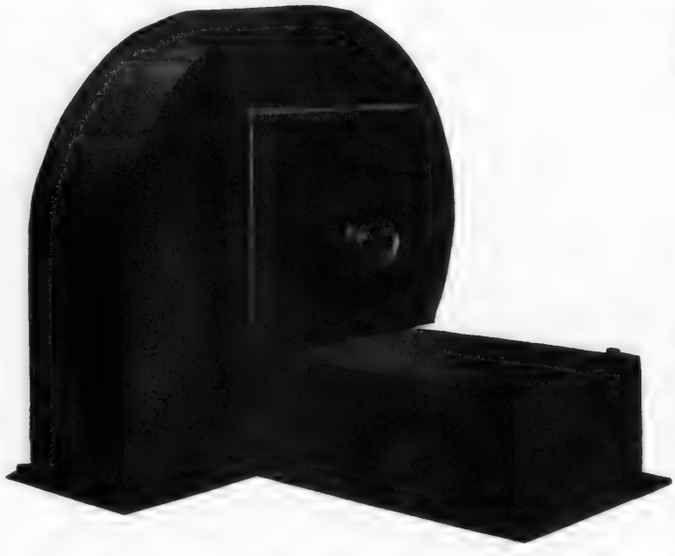
"human engineers," in private employment now, and gives, as one reason, that there are few men with the all-round training the specialty requires. The "human engineer," it is predicted, will first of all be called on to determine if an applicant who is fitted by training or otherwise for a job he seeks is physically capable of filling the position. To do this intelligently, the "human engineer" must familiarize himself with the different jobs in the plant, with the different steps in the manufacturing processes, and then formulate a set of standards with which the applicant must comply in order to fill the position to the best interests of both his employer and himself. It is pointed out that many communicable diseases can thus be detected and their introduction to a factory prevented. The writer quotes the statement made in a recent bulletin of the Public Health Service, that "a contented and healthy worker can produce far more than a dissatisfied and sick worker, and industrial management is learning the simple lesson that it pays to keep a man well and happy."

New York State Industrial Commission has issued a warning to employers to carry compensation insurance under the workmen's compensation law. Failure to do so, it is stated, results in many cases of hardship to widows and orphans every year and to injured workmen whose awards cannot be collected because employers violated the law requiring insurance and are unable financially to make payment themselves. The notice points out that failure to carry such insurance is a misdemeanor punishable by a fine up to $1000, by imprisonment up to one year, or both. The Industrial Commission, through its counsel, it is stated, will proceed vigorously against any employer who continues to disregard this important law.

Building Construction Relief is in sight for those whose buildings and homes are being delayed because lumber, cement and other materials are being held up by the railroads, according to an announcement by the Senate Committee on Reconstruction and Reproduction. This promise is based on the statement made before the committee by Daniel Willard, president of the Baltimore & Ohio Railroad and chairman of the Advisory Council of Railway Executives. He said that while the priority orders of the Interstate Commerce Commission give shipments of coal the preference, it was his opinion that the completion or repair of apartment houses, residences, roads and streets and similar undertakings, should be classed as an emergency, so far as the railroads are concerned, and treated as such. The practical workings of the plan proposed has been to appoint committees representing the construction industry in various districts. In cases brought to their attention, where building material is being delayed, the construction committee will pass upon the necessity for the building, and upon the construction committee's recommendation, a committee of railroad officials will see that the material arrives. The plan is already in operation, W. H. Truesdale, president of the Delaware, Lackawanna & Western Railroad, being in charge of the railroad committee. The construction interests are represented by large committees in New York, Philadelphia and Baltimore, Boston, Cleveland and Chicago. Those on the New York committee include Dr. J. T. Duryea, president of the Piere Pierce, Butler & Pierce Mfg. Corporation and T. N. Gilmore, of Dwight P. Robinson & Co. In Cleveland one of the committeemen is C. F. Lang, of the Lakewood Engineering Company. Complete lists of the committees in each of the cities named may be had from the Senate Committee, 29 West 39th Street, New York.

Washington.—Somewhat lower prices of foodstuffs as the result of bumper crops in all parts of the United States is predicted by A. W. Douglas, chairman of the Committee on Statistics and Standards of the Chamber of Commerce of the United States, in his monthly bulletin on crop and business conditions. According to Mr. Douglas, receipts of grains at primary points have not been heavy, largely due to lack of cars, yet prices have been on the toboggan slide because of a great surplus, which, sooner or later, must find not only a domestic but a foreign market.

"There is no longer any question as to an abounding harvest in all manner



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SERI-VANE FANS

Our engineers are at your service for the designing and installation of a complete modern heating and ventilation system with automatic humidity control. Why do all the large industrial plants with wide awake, up to the minute executives insist on proper ventilation for their employees? There is a reason.

Write for Catalogue Number 70

THE NEW YORK BLOWER COMPANY

513 Transportation Building
CHICAGO, ILL.

Works, LaPorte, Ind. **Branch offices in all large cities**

WE MAKE FANS FOR ALL PURPOSES

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

Interior Industrial Works, Bay City, Mich., showing special arrangement of heating ducts.

Sirocco equipment in use at Industrial Works.

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TRADE MARK

Heating and Ventilating the Industrial Plant

The importance of heating and ventilating the industrial plant is recognized today to a greater extent than ever before.

The Industrial Works Company plant, Bay City, Michigan, is one of America's model plants. The view at the upper left shows the special arrangement of heating ducts. The upper right view shows SIROCCO Equipment which makes possible the every-day, all around satisfactory heating and ventilating service of which the plant boasts.

Whether it is for industrial plant or public building there is a type of SIROCCO Equipment to fit the need.

Would you be interested in our new book "A B C Equipment for Shops"? A copy will be sent on request.

AMERICAN BLOWER COMPANY

Detroit **Michigan**

of agricultural products," says the report, "The winter wheat crop will be about 535,000,000 bushels and the spring wheat not less than 275,000,000 bushels despite severe local damage by black rust in some states in the Northwest. With a few more timely rains there will be 3,000,000,000 bushels of corn, of which the southern States will furnish about one-third. Texas has the greatest corn crop in its history, while Kansas has the unusual accompaniment of large corn and wheat yields in the same season.

Federal Department of Health for Canada is again proposed, the recommendation being made by the Committee on Sanitation and Legislation of the Canadian Society of Domestic Sanitary and Heating Engineers, through John Wright, chairman. "In this country," states the report, "the effect of a well-organized and equipped federal department of health would do much to strengthen the hands of various provincial heal authorities. One of the essential features in the application of sanitation to the general health of the community is efficient methods of sanitary plumbing, heating and ventilation." In the Dominion of Canada, continues the report, there are no generally-recognized standards regarding ventilation and plumbing, but the dominion is governed by a multiplicity of laws and by-laws, adopted by the governing bodies of various cities and towns and enforced according to their own interpretations."

Associated General Contractors of America announce the appointment, as general manager of the association, of Brigadier-General R. C. Marshall, Jr., former chief of the Construction Division of the Army. General Marshall took office July 1. The selection of General Marshall, it is stated, marks the beginning of an active campaign which will include the development of the publication and information service, the contractors' service corporation, the legislative service and other service bureaus of the association, and the several members' divisions, including the building contractors' division, the public works contractors' division and the railroad contractors' division. It is stated that the membership of the association now comprises 700 construction firms representing 36 States and 150 cities. In entering upon his new duties, General Marshall stated, among other things: "No one who has been closely associated with construction interests during the past two years could fail to feel the growing influence of the Associated General Contractors. In New York or Los Angeles, in New Orleans or in Minneapolis, in Washington or in Portland, "Associated General Contractors" has come to mean a new purpose of far-sighted, constructive endeavor and a new spirit of co-operation. It has been evidenced not only in dealings between contractors and government departments, such as the Construction Division with which I am most familiar, but also between contractors and engineers, contractors and architects, contractors and labor, between one contractor and another. The extension of this effort on behalf of general contractors to every vital problem affecting their interests is not merely an ideal, but a practical, possibility, the scope of which is unlimited."

Construction Wages in a number of representative cities have been compiled by the Associated General Contractors and published in a recent issue of the association's *Bulletin*. The scale for steam fitters is as follows in the cities named: Montgomery, Ala., $1.00 per hour; San Francisco, Cal., $1.25; San Jose, Cal., $1.25; Wilmington, Del., $1.00; Washington, D. C., 92½ cents; Springfield, Ill., $1.00; Richmond, Ind., 87½ cents; Sioux City, Ia., $1.12½; Waterloo, Ia., $1.00; St. Louis, Mo., $1.25; Fargo, N. D., $1.00; Little Falls, N. Y., 90 cents; Cleveland, O., $1.25; Aberdeen, S. D., 87½ cents; Redfield, S D., 87½ cents; Dallas, Texas, $1.50; Seattle, Wash., $1.00; Los Angeles, Cal., $1.00; Oakland, Cal., $1.12½; Terre Haute, Ind., $1.00; Fall River, Mass., $1.00; Salem, Mass., $1.15; Buffalo, N. Y., $1.00; Troy, N. Y., 87½ cents; Newark, O., $1.00; Pittsburgh, Pa., $1.00; Salt Lake City, Utah, $1.12½; Milwaukee, Wis., 87½ cents.

Building Guilds for England, to function as a National Guild of Builders are again brought into prominence as an interesting possibility by its supporters in that country. The national guild is expected to develop from the

LEHIGH

The patented construction of the "Lehigh" Multiblade Fan Wheel produces remarkable capacities.

The new Lehigh Data Book and catalog is of unusual interest to every engineer. In addition to multiblade fans, it treats of steel plate, planing mill exhaust, and other fan types, air washers, dust collectors, roof and mushroom ventilators, etc. The engineering data is particularly interesting. Write for your copy.

HERSH BROTHERS COMPANY
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ALLENTOWN, PENNA.

St. Paul's Best Buildings are Carrier Equipped

Carrier Air Washers insure an abundance of pure, fresh warm air in winter, or cool air in summer—absolutely free from disease breeding dust, and containing just the right amount of moisture.

These conditions are at all times under perfect control, insuring health, comfort and greater efficiency.

Write Dept. 36 for catalog and engineering data.

Carrier Air Conditioning Co. of America

Buffalo N. Y.

1. Athletic Club, St. Paul, A. H. Stern, Architect.
2. Public Library, St. Paul, Electus D. Litchfield, Architect.
3. St. Paul Cathedral, E. L. Masqueray, Architect.
4. Minnesota State Historical Bldg., St. Paul, Clarence H. Johnson, Architect.

Buffalo

Building Trades Parliament which has now been established for nearly two years. It is stated that the Building Trades Parliament has already gone far to change the whole temper of the industry it represents. In the interim report of its Management and Costs Committee the statement is made that "we have glimpsed the possibility of the whole building industry of Great Britain being welded together into one great self-governing democracy of organized public service, uniting a full measure of free initiative and enterprise with all the best that applied science and research can render." The plan for a National Guild of Builders will come up for public debate in the Building Trades Parliament within the next few months. It is described as essentially a great combine under democratic control, organized for the service of the community and setting out primarily to secure for that service the immense advantages of industrial combination. These include such matters as the assured and steady supply of materials, purchased in bulk throughout the world; the standardization of products, the co-operative use of plant and transport facilities, the utilization of by-products, the financing of contracts, the unification of advertising and selling organizations, the interchange of data and experience, the promotion of scientific and technical research, and the regular development of real craftsmanship by the holding of continuous exhibitions of individual works of art throughout the country.

Manufacturers' Notes.

Detroit Brass & Malleable Works, Detroit, Mich., is the new name of the Detroit Valve & Fittings and Detroit Brass Works. At the time of the consolidation of the Detroit Valve & Fittings Company and the Detroit Brass Works, it was deemed advisable to combine the names of the two companies so as not to lose the identity of either plant. It is felt that the trade has now become thoroughly acquainted with both branches so that the company's name can be shortened. There is no change in the policy or management.

Wm. H. Page Boiler Co., New York, has leased and stocked a warehouse in Boston, at 379 Commercial Street, to take care of the company's growing trade in New England. The new warehouse is located at the Battery Station of the Boston Elevated Railroad and known as Battery Wharf. It is adjacent to all steamship lines covering the entire coast and near all express offices and freight terminals. This will enable the company to land its boilers in Boston by boat and rail from its factory in Meadville, Pa., and from its general distributing warehouse at Bush Terminal, New York. The Boston warehouse has a capacity for several carloads of Page boilers. Complete stocks will be carried both round and sectional Volunteer and Monarch boilers. The company's Boston sales office will remain at 100 High Street.

United States Radiator Corporation, Detroit, Mich., has opened a branch office in Portland, Me., containing 10,000 sq. ft. of floor space. Charles A. Maynard, who has long represented the company in Maine, has been appointed branch manager. Another branch of the company has been opened in Springfield, Mass., to supply western Massachusetts and parts of Vermont, New Hampshire and northern New York. W. C. Brandeau, for several years connected with the company's Boston office, has been made manager.

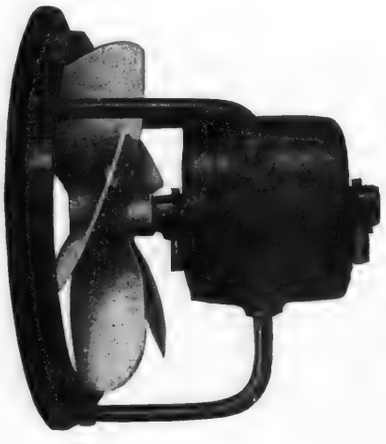
Walker & Pratt Co., Boston, Mass., will build a one-story foundry, 200 x 230 ft., at its Watertown works, to increase its facilities for manufacturing its line of heaters. Lockwood, Greene & Co., 60 Federal Street, Boston, are acting as architects and engineers.

Syracuse Vapor Heat Co., Syracuse, N. Y., has increased its capital stock from $40,000 to $75,000.

Norristown Magnesia & Asbestos Co., Norristown, Pa., has increased its production capacity 50% through the erection of an addition to its plant in Doylestown, Pa.

American Blower Co., Detroit, Mich., has purchased the foundry of the Lane & Bodley Co., Cincinnati, and will remove its foundry department from

"WING-SCRUPLEX" RELIABILITY



When you select a certain "WING-SCRUPLEX" Fan from our catalog to deliver a given number of cubic feet of air per minute, you get all that is promised—and more—That's RELIABILITY.

Every time you specify or install a fan, your reputation is at stake—"WING-SCRUPLEX" Fans protect that reputation.

Besides this you are absolutely protected on price. That is the commercial end of it, and is of interest to you, of course.

It is our business to manufacture these products, and your business is selling and installing such things. Therefore, you must have RELIABLE price protection.

L. J. Wing Mfg. Co.

Hudson and 13th Streets
N. Y. CITY

Sturtevant
PUTS AIR TO WORK

Amicable Life Building, Waco, Texas
SANGUINET AND STAATS, ARCHITECTS
J. A. OSBORNE, ENGINEER

Oliver Hotel, South Bend, Indiana

Empress Theatre, Sacramento, Calif.

WHY DOES MANUFACTURER RESEARCH DETERMINE CONTRACTOR SUCCESS?

Have you ever been disappointed with your heating and ventilating jobs because the volumes and capacities of fans failed to meet your specifications?

Engineers and contractors *do* experience such situations and usually it is because they have specified or bought apparatus minus—manufacturer research and engineering.

Assurance of the success of a job rests in constant research and attention to manufacturing detail. Any amount of effort exerted by the engineer or contractor cannot overcome errors made in manufacture. It is apparent, therefore, that installation success is the outcome of constant research plus well-made apparatus, the real merit of which is proven by year in and year out performance.

In all classes of buildings and under all conditions of operation Sturtevant systems prove successful. We manufacture heating and ventilating equipment suitable for dairy lunch or skyscraper with equal attention to the requirements of either.

Consult any one of our sales-engineering branches or write to Hyde Park for literature, stating the class of building you are interested in.

B. F. STURTEVANT COMPANY
HYDE PARK, BOSTON, MASSACHUSETTS
AND ALL PRINCIPAL CITIES

West High School, Cleveland, Ohio

Unitarian Church, Cleveland, Ohio
BRIGGS AND NELSON, ARCHITECTS

Detroit to Cincinnati. Labor trouble, it is reported, have induced the company to secure the Cincinnati location. The company's purchase includes 21 acres, with buildings containing 90,000 sq. ft. of floor space. It is expected that by the first of the year 500 men will be employed in the Cincinnati plant.

Sims Co., Erie, Pa., are building an addition to its plant, covering a space of 50 x 240, which will greatly increase its capacity for the manufacture of the Sims line of water heaters and other products.

C. A. Dunham Co., Chicago, Ill., is planning a two-story addition to its plant in Marshalltown, Ia., to cost $150,000.

Fischer-Sweeney Bronze Co., Hoboken, N. J., manufacturers of castings, has increased its capital stock from $100,000 to $200,000.

Uehling Instrument Co., New York, manufacturers of fuel economy equipment, announces that it is now represented in New England States by the Smith Engineering and Supply Co. 89 State St. Boston, Mass. manufacturers' agents and engineers, specializing in power plant equipment. S. W. Smith, president of the latter company, was Uehling Instruemnt Company, with headquarters in the New York office.

Central Station Heating Notes.

Joliet, Ill.—The Intercity Utility Service Company has filed a petition with the State public utilities commission asking for a "certificate of convenience and necessity" to construct and operate a steam and water heating system in Steger, Crete Township, Ill. At the same time they asked for authority to issue $103,000 of common stock and $18,200 of preferred stock.

Springfield, Ill.—Poposed increased rates for steam heat service in Hillsboro of the Southern Illinois Light & Power Company were suspended by the State public utilities commission to December 13, 1920. Proposed increased rates for heating service in Paris of the Central Illinois Public Service Company of Mattoon were suspended until December 13; in Mattoon until December 13; in Charleston until December 11; and in Tuscola until December 13.

Mt. Carmel, Ill.—The Public Utilities and Service Company has filed a petition for permission to abandon its heating plant at that place. Hearings will be held before the State public utilities commission takes action.

Taylorville, Ill.—A tentative schedule of rates for heating service has been put out by the Central Illinois Public Service Company, amounting to double the amount of the original flat rate. At a conference held with the city council the new rates were accepted. The agreement provides that the rate shall remain in effect only as long as the city continues to allow the company to light the streets. This would mean that Taylorville will have to abandon its plan to erect a municipal lighting plant.

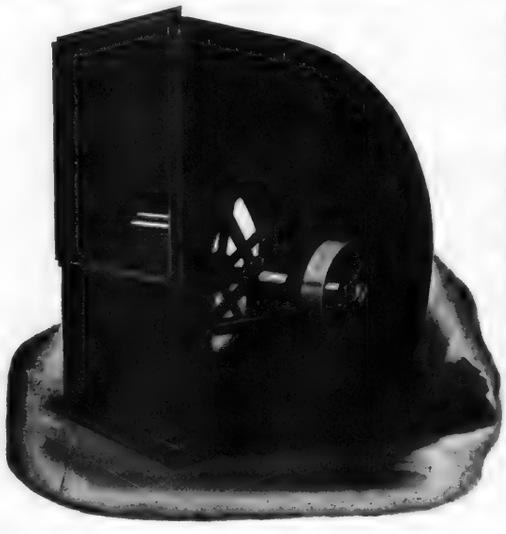
Charleston, Ill.—In the hearing on the petition of the Central Illinois Public Service Company for permission to abandon its plant in Charleston, it was stated by the representatives of the company that the operating expenses for the heating plant during the past season exceeded the total revenue by $6,200. The consumers are opposing the proposed abandonment of the plant.

Tacoma, Wash.—Permission has been granted to the Consumers' Central Heating Company to use three vacant lots owned by the city on Dock Street, facing the city waterway, for the erection of a $500,000 heating and power plant. The company has the privilege of first making soundings on the property. The lease will run for five years. In its application to the city, the company declared that the owners of the old plant, which was recently burned, had decided not to rebuild and the company, therefore, was obliged to make other arrangements at once for supplying heat to its customers. The company agrees to put in a plant that will generate 1600 H. P. of electric current, in addition to providing steam heat for its piping system, and will give the city first option on the purchase power at a low rate.

Belvidere, Ill.—Work has commenced on the new central heating plant in Belvidere, being built by the Belvidere Heating Company. As it

Buckeye Multiblade Fans

are made especially for low pressure Heating and Ventilating work. They are giving perfect satisfaction.



CORRECT DESIGN. HEAVY CONSTRUCTION, NOISELESS OPERATION, WORKMANLIKE FINISH, HIGHEST EFFICIENCY.

Our Engineering Department is maintained for the purpose of assisting Engineers, Architects, etc., in planning efficient Heating and Ventilating Systems for all buildings.

THIS DEPARTMENT IS FREE TO YOU.

We also manufacture a complete line of Disc, Cone and Steel Plate Fans.

Write Department D

BUCKEYE BLOWER CO.

COLUMBUS OHIO.

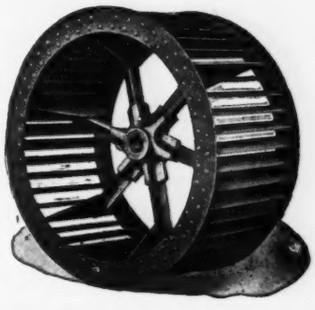
CAPITOL THEATRE NEW YORK

IN this the most modern and up-to-date and perhaps the finest theatre of its kind in the world,

Massachusetts Fans

were selected to take care of the fresh air supply and exhaust systems. Seven large "Squirrel Cage" fans and two Massachusetts Davidson propeller fans were installed, the four main fans supplying and exhausting respectively 140,000 cubic feet of air per minute, while the smaller fans exhaust 20,000 cubic feet of air per minute from the lavatories, smoking room, etc. One hundred horse power is required to operate the plant.

Where may we send you ALL the facts on MASSACHUSETTS FANS?



MASSACHUSETTS BLOWER CO.
WATERTOWN, MASS.

will not be possible for all of the steam mains to be laid in time for the next heating season, permission has been obtained from the Illinois Northern Utilities Company to use the system of hot water mains now in the ground and which have been used for circulating hot water from the plant of the utilities company. The new company proposes to use portions of this system to heat residences which cannot be reached this year by the new pipe system. The new company, in laying its pipes, will follow the ditches of the old company. The mains in the business section, it is stated, will be in this season. Beyond that heat will be furnished through the mains of the old water heating system. As the new pipe lines follow the old, connections will be made at the point where work ceases in the Fall, and from there on steam will be circulated through the old system. Next season the company expects to take up the work of extending the new line to adjacent residence districts where there are sufficient patrons.

A proposition was made to the new company to throw out the iron pipes of the old line as work proceeded, the utilities company to junk them and pay the new company 25% of the proceeds. It is stated that on this basis it would hardly pay to retrieve the old pipes.

The plans for the new system are being put through on the basis of subscriptions from owners of residences ranging from $500 to $1000 each. For stores of the ordinary size, the minimum subscription has been set at $1000.

New Incorporations.

Polcin Water Heater Co., Rock Island, Ill., capital $10,000, to manufacture water heaters. Incorporators: B. J. Lachner and James F. Murphy.

Lange Boiler Co., Elyria, O., capital $100,000, to manufacture steam and water boilers. Incorporators: H. J. Lange, Lorain; J. A. Lucas, Elyria, and others.

Harris Packless Valve Co., Springfield, Mass., to manufacture valves. President, George W. Harris; treasurer, Charles L. Young. These officers and Willis E. Maynard constitute the board of directors.

Milwaukee Boiler Mfg. Co., Milwaukee, Wis., capital $200,000. Offices have been opened at 220 Oregon St. Incorporators: I. M. Bean, Otto H. Ehbe and W. D. Johnson.

Petroleum Heat & Power Co., New York, capital $500,000, to manufacture oil-burning appliances. Incorporators: F. M. Forbes, S. Whitaker and R. Adamson, 511 Fifth Avenue. The company has acquired a plant at Stamford, Conn., and will shortly build a one-story foundry addition.

WANTED

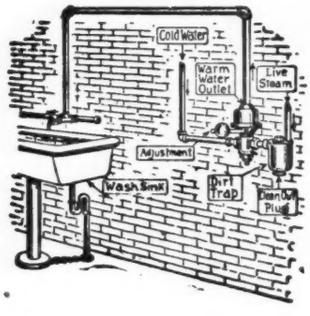
Advertisements under this heading, $2.00 per inch, payable in advance. A 1-in. advertisements contains 35 words. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.

Heating and Ventilating Engineer, now employed in executive position, desires connection with industrial concern, heating contractor or consulting engineer. Technical college graduate, licensed professional engineer, member American Association of Engineers. Capable of handling electrical work. Address Box 25, care of HEATING AND VENTILATING MAGAZINE.

Wanted. — Heating engineer and salesman. Address Moheco, Box 30, care of HEATING AND VENTILATING MAGAZINE.

Wanted—A man of broad experience to take charge of the engineering department of a company which manufactures blower apparatus. Address Box 75, care of HEATING AND VENTILATING MAGAZINE, giving full particulars as to experience and salary demanded.

H. A. Erickson, formerly of New York, and who recently was engaged as assistant engineer on one of the Shipping Board's steamers in the Orient, has been appointed manager of the construction department of the American Heating Supply Co., in Rockford, Ill.



The Powers Steam and Water Mixer

Like all other Powers apparatus, the Steam and Water Mixer is a sturdy, dependable machine—it never fails. That's the reason we believe it should be installed on **your** workmen's wash sinks and shower baths.

Safety and Economy

The Powers Steam and Water Mixer is the safest, simplest, and least expensive installation for supplying hot water.

Mixes live steam and cold water and supplies water of the desired temperature with never any danger of scalding water getting to the faucets.

Adapted to Wash Sinks, Shower Baths, etc., wherever high pressure steam is available. Absolutely anti-scalding.

The Powers Regulator Company

SPECIALISTS IN AUTOMATIC HEAT CONTROL

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McKim, Meade & White, Architects

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Like Men, Motors Must be Specialists—

So varied is the character of work—so different are the requirements of each individual job, that no one type of motor should be expected to successfully operate under all conditions.

Westinghouse engineers realized long ago that the requirements of each class of business should be carefully studied and that a motor should be especially designed to meet these requirements.

After a careful analysis of requirements in the heating and ventilating field, they have produced a motor, which like themselves is a specialist.

The heating and ventilating equipment in the Hotel Pennsylvania, New York City, is a noteworthy example of the effectiveness of their ability in this line.

Ask for Catalogue No. 7193

Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.
Sales offices in all large cities

Westinghouse

Variation of Overhead Expense Among Cleveland Heating Contractors.

One of the most interesting reports presented at the recent convention of the Heating and Piping Contractors' National Association was that giving the results of a survey of the actual overhead expense of sixteen heating contracting firms in Cleveland for 1919. In this investigation it was decided to base the "overhead" on the direct job costs, namely, labor and material, rather than on the selling price.

The results were presented in two charts, the first covering the larger group in which the direct costs amounted to sums ranging from $90,000 upwards to $225,000. The total direct costs for the nine firms listed on this chart amounted to $1,405,375 at an overhead expense of $262,232 or 18.9%. The individual "overheads" ranged from 11.5% to 27.4%. The study disclosed the fact that the variation is not due to rent, depreciation, taxes or insurance, but is caused by the values placed on themselves and assistants by the various proprietors.

One of the conclusions reached by the committee in this connection is that many contractors seem to be satisfied with proceeds that are rightfully the returns on capital invested, as compensation for their efforts.

The second chart covered the smaller group, with the direct job costs ranging from $30,000 to $68,000. The percentages in this class range from 15% to 30%. The seven shops listed have a general average "overhead" of 22.1%. It was brought out, in this chart, that the smaller firms give very little consideration to proper accounting methods.

The complete figures of both charts are given in the *Official Bulletin* of the Association for August, 1920.

Get Posted on the McDonald Under-Seat Valve

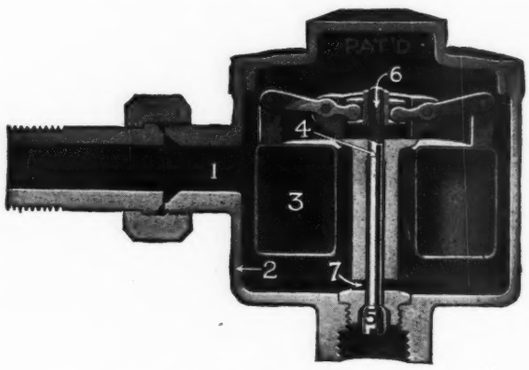
There are so many advantages to the McDonald Under-Seat Valve that Architects, Heating Engineers and Contractors are now using them in great quantities. Here are just a few additional advantages of this wonderful valve:

No. 1. Automatically self cleaning.

No. 2. Carries away all scale.

No. 3. The entire inside of valve instantly removable by loosening a cap.

No. 4. It is an absolute fact that the McDonald Under-Seat Valve will handle and discharge a much larger quantity of water than any other trap or valve of equal size.



No. 5. Gives perfect service on any radiator, connected on a two pipe heating system and under any pressure ordinarily met with in any heating, up to and exceeding ten pounds.

No. 6. It will take care of condensation of any radiator, having a direct heating surface of 300 sq.f or less.

The McDonald Under-Seat Valve
Patented

The Only Under-Seat Valve on the Market

Examine the above valve and note its simplicity: (1) Inlet, (2) Valve Body, (3) Float, (4) Rod (5) Seat with Capillary Air Port, (6) Air Passage Connecting with Capillary Port, (7) Removable Post.

Hissing, cracking, knocking, escaping steam, uneven temperature, all are done away with when the McDonald Under-Seat Valve is attached to a radiator.

For further particulars address The McDonald Under-Seat Valve Co., 602 Swetland Bldg., Cleveland, O

Interior View Showing Copper Coil

The New Excelso Water Heater

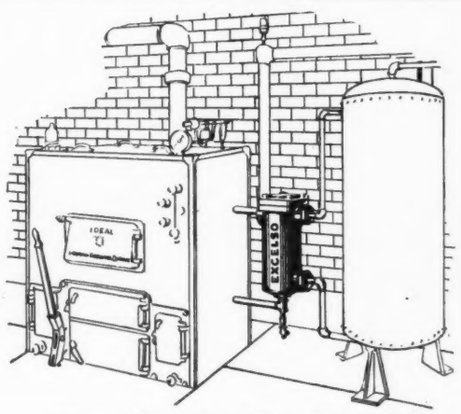
Eliminates Fire-Pot Pipe Coils

The Excelso Heater, connected below the waterline of steam or vapor boilers, will generate domestic hot water constantly, day and night, as long as there is any fire, at practically no cost.

The copper coil is connected into heater without packing. Made in five sizes for tank capacities as follows:

No. 1	No. 2	No. 3	No. 4	No. 5
30 gal.	45 gal.	70 gal.	90 gal.	120 gal.

EXCELSO SPECIALTY WORKS
119 Clinton St. Buffalo, N. Y.



Connectde to Ideal Type "A" Boiler